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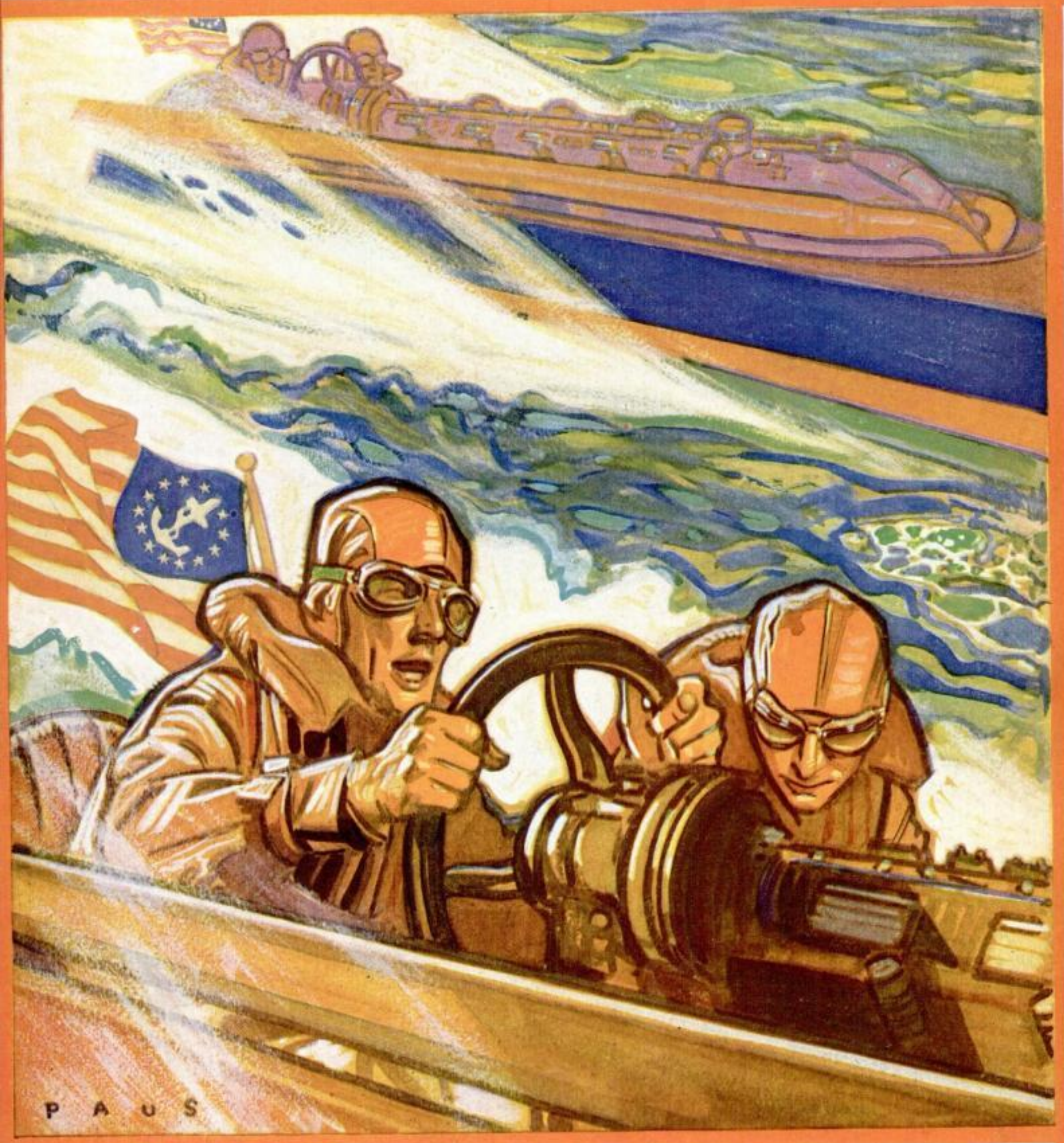

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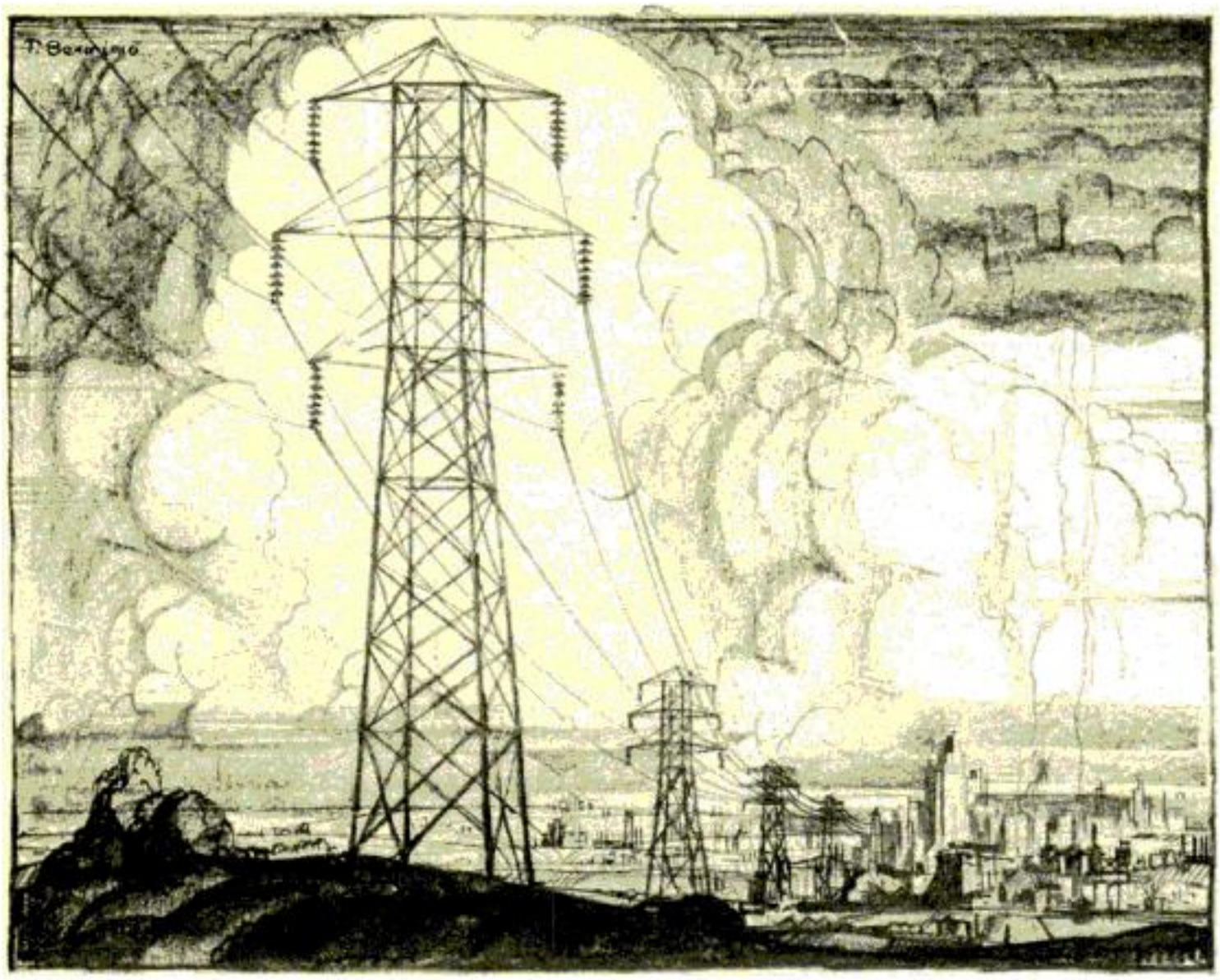

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The greatly enlarged business in new Cadillacs and La Salles has increased the size of Used Car stocks now in the hands of Cadillac-La Salle dealers.

These stocks are, also, far more varied.

The strong trend to Cadillac-La Salle is, to a marked extent, the result of a change in buying habits. Many who thought they must confine themselves to cars of lower price are now purchasing new Cadillacs and La Salles because they are convinced that, regardless of first cost, they offer a sounder and more satisfying investment.

Therefore a greater variety of makes in good Used Cars is available.

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CADILLAC MOTOR CAR COMPANY

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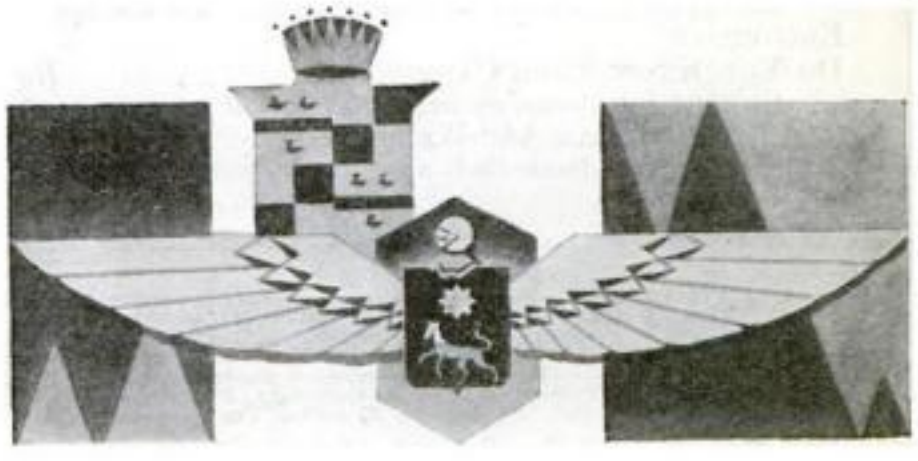

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June, 1929, Vol. 114, No. 6. **Popular Science Monthly** is published monthly at 250 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Chicago, Illinois. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Single copy, 25 cents. Yearly subscriptions to United States, its possessions, and Canada, $2.50; foreign countries, $3. O. B. Capen, President and Treasurer; R. C. Wilson, Vice-President; A. L. Cole, Secretary.

Health and Hygiene

Laboratory Discoveries

Nature

New Devices for the Home

New Processes and Inventions

Photography

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For the Home Owner

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Ideas for the Handy Man

Hundreds of Striking Articles in This Single Issue Cover from Every Angle the Latest Developments in the World of Invention and Discovery

Pinning TAILS ON DONKEYS

By WALLACE AMES, *Financial Editor*

Being the financial editor of a New York newspaper, Gary Clark's friends were continually hounding him for stock market tips. He was the only one in his set sufficiently familiar with the market to realize that he had no "sure things" to pass out. His idea in giving the party was to demonstrate the hazards and expose the folly of the pet systems of speculating which were in vogue among so many of his friends.

The first feature on the evening's program was that old-fashioned game of pinning tails on a donkey. The picture of a tailless donkey was hung on the wall of the living room. Each guest was given a tail and a pin. In turn each one was blind-folded, whirled around until somewhat dizzy, then left to grope for the proper place to pin the tail. Bursts of laughter greeted each grotesque attempt. Of course no one succeeded in pinning a tail where it belonged.

After each guest had furnished amusement for the other, the game broke up and Gary announced that the next feature would be a lesson in high finance.

"In your various attempts to pluck some easy profits from stocks, you folks remind me of the donkey and tail game we have just played. Don't shoot . . . I am not calling you donkeys. What I want to say is that you try to pick winners in the market with about as much vision as you used in pinning tails on the donkey. And you hit just about as close, most of the time.

"You are all people in comfortable financial circumstances, as the natural result of the fact that you know your business. You render valuable service in return for the salaries, fees, commissions or profits that you get. In your own lines of business you appreciate the value of training and you know enough not to expect something for nothing. But when it comes to the stock market every one of you seems to possess two common American characteristics. Just because you are a good doctor, a successful advertising man, or a prosperous merchant you seem to think you know something about stocks and the stock market. While you are aware that there is no easy road to riches in your own business, you still cling to the idea that there is easy money in Wall Street labeled with your name. If optimism could be indorsed and cashed you would be the richest people in the world. If there really were pots of gold at the end of the rainbow you would have them all, for you surely are champion rainbow chasers."

"Them's strong words, Gary," broke in Tad Watters, one of the guests at the party. "And as far as my method of selecting securities is concerned, what you have said amounts almost to a condemnation of your own work as financial editor. I have long been a close student of the financial sections of our daily newspapers. I read almost everything that is printed about securities and determine what to buy and when to sell it by keeping up to date on developments."

"Fair enough, Tad," replied Gary. "Your method seems plausible, on the face of it. But don't you know that it is not ethical function of a newspaper to print tips, rumors and certain forms of gossip regarding the stock market. There is a lot going on in the financial world that does not appear in the news columns.

"In the majority of cases, when favorable news gets into print the cream of the profits have been lapped up. There is a stock phrase in Wall Street, 'Now the news is out.' And when the news is out stock prices almost always move in the opposite direction to what you would expect. On favorable news stocks usually go down. Unfavorable news more than likely puts stock prices up. The explanation of this phenomenon is that the development which finally becomes news has already been discounted—perhaps overdiscounted. When good news is out, the selling by insiders who already have their profit frequently causes a reaction. When bad news comes out, 'short covering' and other buying is likely to put the stock up a bit. By the time you get around to buy or sell the show is nearly all over.

"I see you smile, Dave Roberts," continued Clark, "and I know just what's in your mind. You are smarter than Tad Watters, you think. You don't get your information from the newspapers. You get it hot from the broker's office, from market letters, from whisperings around the stock ticker.

"I know a lot of stock brokers. Everyone of them is sincere in his endeavor to render genuine service to his customers. You can reasonably depend on a broker to give you his best judgment. Occasionally he may know something of real market significance about a given security. But the number of influences continually hanging over the stock market is legion. One never knows what will happen, or the origin of its source, that will start the market up or down.

"A certain stock may be cheap. Under favorable circumstances it should advance in price. But if a totally outside situation develops of an unfavorable character causing a general selling movement the cheap stock may go down along with the

(*Continued on page 5*)

Pinning Tails on Donkeys

(Continued from page 4)

rest. Let me explain one of the reasons for this common occurrence. Suppose you hold two stocks, 'A' and 'B.' You incur a big paper loss in 'A.' You have no loss in 'B.' You decide to carry 'A' until its price recovers and to protect your account you sell 'B.' Other speculators are doing the same. The result is heavy selling of 'B.' It was the weakness of 'A' that caused a decline in the price of 'B,' not any intrinsic weakness in 'B.'"

"We all agree," injected Sam Douglas, "that stock prices may go down as well as up, but is it not true that stop-loss orders protect us against heavy loss?"

"I thought that, too," spoke up George Cross, "until the last week in March of this year. What a trimming I got through depending on stop-loss orders! You will all remember those two days last month. Call money rose to 14% one day and mounted to 20% the next. Prices collapsed like a house of cards. Then suddenly, when the fear of a money panic was relieved, the tide turned, prices leaped upward and before the week was over stocks were selling at higher levels than before the crash occurred.

"At the time I was carrying three or four stocks. In each case I was protected—so I thought—with a stop-loss order five points below my purchase price. For example, I paid 96 for one stock and put in a stop-loss order at 91. In case of a drastic decline in that stock my loss was limited to 5 points.

"You can imagine what happened during those two eventful days. Each of my stocks fell to the stop-loss price. My selling orders were executed. I took my losses. In but a few hours every one of those stocks was again selling for more than I paid originally. If I had not been closed out through stop-loss orders, and had hung on only 48 hours, I could have then sold every one of my holdings at a small profit. Some experience!"

"Arch Henkle looks as though he had a chip on his shoulder," continued Clark, as he directed his fire at another member of the group. "Arch, while you were listening to the sad experience of George Cross, you were feeling pretty good about that 100 shares of ——— ——— that you bought a few months ago."

"Why shouldn't I?" said Arch. "I guess I am the exception that proves your rule. That stock doubled in value within a few weeks; the shares were split two for one; I sold and cleaned up $10,000 profit."

"Let me tell the rest of the story," suggested Gary. "You sold out at 112. So far, so good. But when the price of that stock kept climbing you bought in again at 118 on information that it would hit 500 before the year is out. Maybe it will, but where do you stand today?

"Very few people take any money out of Wall Street and keep it. Most of those who make a profit on one deal lose it on another. If any of you would take the trouble to compute your gains and your losses for the past year I would be willing to wager that, *(Continued on page 6)*

Pinning Tails on Donkeys

(Continued from page 5)

even if you have a profit it would not amount to more than 6%—which you can easily get without any speculative risks.

"But listen, Gary," said Tracy Randall, "what do you think we should do? Don't you buy stocks yourself? Do you or don't you practice what you are preaching to us? In your opinion are bonds the only safe form of investment?"

"I *invest* in stocks," answered Clark, "but I do not speculate in them. There is a world of difference. I buy outright as many shares or as many bonds as I have money to pay for, but I never trade on margin."

* * *

In the next issue of POPULAR SCIENCE MONTHLY we will report what Gary Clark had to say when his friends gathered for their second session.

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"How to Build an Independent Income" is the title of a new booklet by the F. H. Smith Company which explains conclusively how people of moderate means may obtain financial prosperity. **"55 Years of Investment Service"** describes the history of progress of the F. H. Smith Company as well as making an attractive suggestion in first mortgage real estate bonds. May be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

"The Investment Trust from the Investor's Viewpoint," presents an explanation of this form of investment in easily understood terms, illustrated with some interesting examples of how the general investment trust will help the man with $100 or more to get ahead. Published for free distribution by United States Fiscal Corporation, 50 Broadway, New York. Ask them for Booklet IT.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

How to Get the Things You Want tells how you can *use* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

The Guaranteed Way to Financial Independence tells how a definite monthly savings plan will bring you financial independence. Write for this booklet to Investors Syndicate, 100 North Seventh Street, Minneapolis, Minn.

The Making of a Good Investment tells how 6½% can be made on investment in First Mortgage Bonds in units of $50, $100, $250, $500 and $1000; how the bonds are protected and how simple it is to purchase them. For a copy of this booklet address United States Mortgage Bond Company, Limited, Detroit, Michigan.

Statement of Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912 of Popular Science Monthly, published monthly at New York, N. Y., for Apr. 1, 1929, State of New York, County of New York, ss. Before me, a notary public in and for the State and county aforesaid, personally appeared Sumner N. Blossom, editor, who, having been duly sworn according to law, deposes and says that he is the Editor of Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 411, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Popular Science Publishing Co., Inc., 250 Fourth Avenue, New York, N. Y., Editor, Sumner N. Blossom, 250 Fourth Avenue, New York, N. Y., Managing Editor, Raymond J. Brown, 250 Fourth Avenue, New York, N. Y., Business Manager, O. B. Capen, 250 Fourth Avenue, New York, N. Y. 2. That the owners are: Popular Science Publishing Company, Inc., 250 Fourth Avenue, New York, N. Y. Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 250 Fourth Avenue, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; Ada B. Wilson, 683 Springfield Avenue, Summit, N. J., L. B. Tunison, 64 E. Lake St., Chicago, Ill.; A. L. Cole, 250 Fourth Avenue, New York, N. Y.; Sumner N. Blossom, 250 Fourth Ave., New York, N. Y.; John Nichols, 250 Fourth Ave., New York, N. Y. 3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: none. 4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner, and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) Sumner N. Blossom, *Editor*.

Sworn to and subscribed before me this 21st day of March, 1929.

Esther Eyl, Notary Public, Kings County. Clerk's No. 87, Registry No. 199. New York County Clerk's No. 258, Reg. No. 0-167.

(Seal) My Commission expires March 30, 1930.

A definite program for getting ahead financially will be found on page four of this issue.

Spring! . . *for everyone but her*

In her lovely Newport garden she stood—a bitter, disappointed, lonely woman at 33.

It was Spring—but in her life there was no romance.

Why was she still single? Once she could have picked and chosen from many suitors. Now she had none. Even time-tried women friends seemed to avoid her. She couldn't understand it . . .

Halitosis (unpleasant breath) is the damning, unforgivable, social fault. It doesn't announce its presence to its victims. Consequently it is the last thing people suspect themselves of having—*but it ought to be the first.*

For halitosis is a definite daily threat to all. And for very obvious reasons, physicians explain. So slight a matter as a decaying tooth may cause it. Or an abnormal condition of the gums. Or fermenting food particles skipped by the tooth brush. Or minor nose and throat infection. Or excess of eating, drinking and smoking.

Intelligent people recognize the risk and minimize it by the regular use of full strength Listerine as a mouth wash and gargle. Night and morning. And between times before meeting others.

Listerine quickly checks halitosis because Listerine is an effective antiseptic and germicide★ which immediately strikes at the cause of odors. Furthermore, it is a powerful deodorant, capable of overcoming even the scent of onion and fish.

* * *

★
Full strength Listerine is so safe it may be used in any body cavity, yet so powerful it kills even the stubborn B. Typhosus (typhoid) and M. Aureus (pus) germs in 15 seconds. We could not make this statement unless we were prepared to prove it to the entire satisfaction of the medical profession and the U. S. Government.

GREAT! That's what men say about Listerine Shaving Cream, so soothing, so refreshing.

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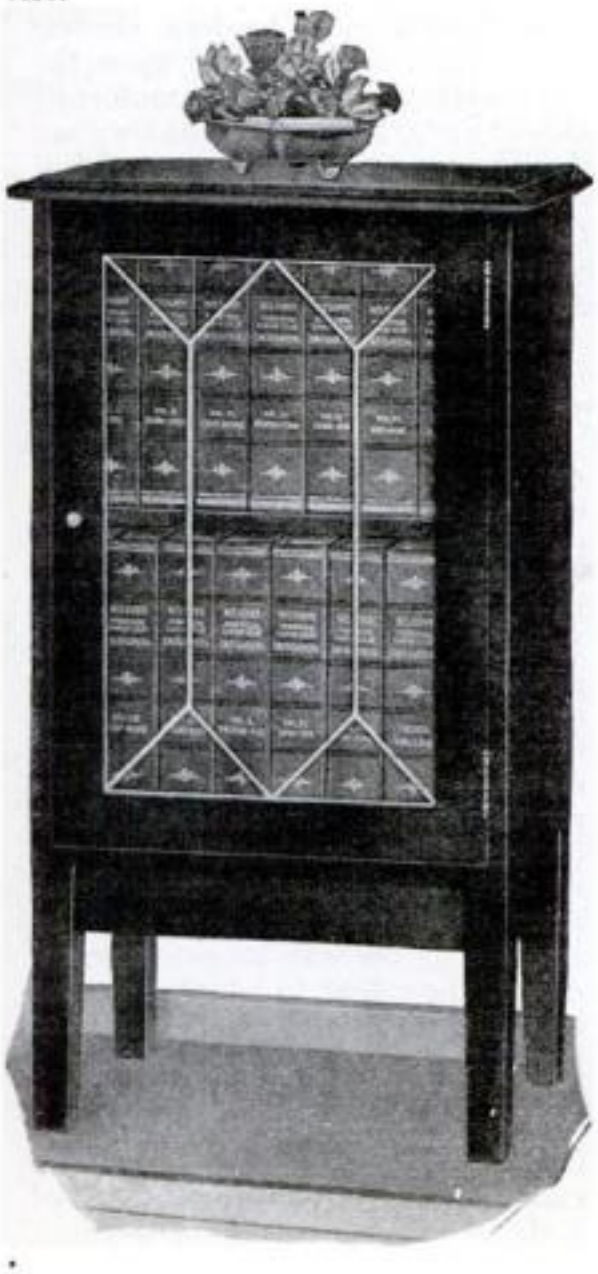

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Why Some Radio Sets Cost More

Price Variations Due to Finer Workmanship and Better Materials

By ALEXANDER SENAUKE, E. E.
Assistant Director
Popular Science Institute

Both receivers are good value, yet one costs $100 more than the other. This article tells why.

MANY people wonder why a radio receiver should cost so much. Where is the value, they ask, in such an apparently simple assembly of metal parts, wires, and so on? And they are further mystified by the difference in price between radio receivers that look nearly as much alike as two eggs out of the same basket.

Forgetting the matter of cabinet, which, of course, is responsible for price differences in some commercial sets, the major price difference is due to features of electrical and mechanical design that contribute directly to the set's performance.

Take, for instance, two sets, one costing $89.50, and the other $189.50. Both have the same number of tubes, apparently distributed in the same way. The $189.50 set has a cabinet somewhat bigger and better than the less expensive outfit, as well as extra details such as voltage control, tone control, and a provision for phonograph reproduction. But even these factors do not explain the hundred dollars difference in price. To listen to the two receivers discloses a difference in efficiency, but the more expensive set certainly is not twice as efficient in all respects. How, then, can both be judged by authorities to be good value? What brings up the price of the one set, and just what features are obtained through the additional expenditure?

THE answer is that a set which will give *good* radio reception can be manufactured at a moderate cost, but a set that will provide *excellent* reception requires rare care in construction besides perfection of materials, which increases the manufacturing cost. A fact which every golfer knows is that it takes twice the skill and practice to cut a score from 80 to 70 as it does to succeed in breaking 90 when one has been playing around 100. In radio, as well, that last degree of perfection calls for double effort—and the buyer pays double for it.

Take, for instance, the matter of making a receiver selective (capable of separating stations effectively), and sensitive (capable of bringing in weak radio signals that come from a distance). The extent to which these features are developed in modern single control receivers depends largely upon the electrical efficiencies of the coils and condensers used, and upon accurate matching of the electrical constants of these parts.

Attaining a really high degree of sensitivity and selectivity calls for the use of relatively large coils manufactured with a high degree of mechanical precision, as well as variable tuning condensers of rugged mechanical design. Great care must be taken in the adjustment and grouping of the parts so that they will be exactly matched. Finally, the entire assembly of parts must be adjusted painstakingly by skilled technicians.

From the standpoint of performance in selectivity and sensitivity, substantial price increase may be justified by the use, in one, of:

1. Greater amounts of material.
2. Closer limits in manufacture of individual parts.
3. More careful matching of contributing units.
4. More painstaking adjustment of the whole set.

TONE quality may justify even greater price differences in modern electric receivers. Tone depends first upon the receiver's ability to reproduce uniformly all notes or audio frequencies, as they are called. The proper reproduction of low tones or frequencies is particularly hard to attain and requires the use of more costly transformers. To get a good response to low frequencies also necessitates the use of greater amounts of filtering material in the power supply units of the receiver to prevent hum.

The degree to which the best tone quality of a receiver may be utilized depends largely upon the type and connections of the amplifier tubes used in the power output stage and the voltages supplied to these tubes. In turn, the type and number of power tubes used and the voltages supplied them affects the cost of the receiver by determining the size and design details of such items as the power supply transformer, filter chokes, filter condensers and the receiver output transformer. Great price differences therefore may be justified by the way tones are reproduced, the extent to which hum has been filtered out, and the amount of power the set is able to handle.

Finally, from the standpoint of a receiver's durability and freedom from frequent breakdown, price differences are justified by the quality of materials, parts, and workmanship.

Meeting "high gear" competition, speeding up factory production —with this *grainless* wood

Just the right material for increased production—what a problem it is to find. But in scores of industries where strength is vital and lightness an asset, the answer has been found in the use of Masonite Presdwood. To try out Presdwood is to realize its profitable possibilities. Samples for research gladly sent on request.

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A material that is light, strong, dense, yet easily handled on standard wood working machines — this description but partially tells the manufacturing advantages of Masonite Presdwood. In addition, this sturdy material is naturally beautiful in appearance and capable of taking any commercial finish.

Because Presdwood contains no artificial binder, it does not dull good tools. It is almost impervious to moisture. It does not split or splinter and is highly resistant to warping, buckling, shrinking and swelling.

Still other advantages are uncovered almost daily. Die costs are reduced on punch press operations. Costly rejections in final inspection are no longer encountered. In many, many ways, this grainless wood board is effecting vast savings in modern industry.

For hydroplanes

The lightness of Presdwood has dictated its use for prize winning hydroplanes, both hulls and decks being made of this grainless wood. It is built into toys that are easy for tiny tots to handle. And because of its resistance to moisture, it is ordered in large quantities by makers of outdoor signs. For tops of campers' tables it gives out-of-door convenience without heavily loading the car. In portable billiard tables it provides a perfect surface and keeps down the weight.

EASILY CUT ON THE BAND SAW

The strength of Presdwood has led to its use in the broad paneled sides of motor truck bodies, on which the buyer's sign can be readily painted. It is used in shipping boxes where merchandise of great value must be adequately protected. It is ideal for show window flooring, office partitions, paneled walls of fine apartments, floors of dance halls and park pavilions, and the decorative ceilings of Pullman-built railroad coaches.

In your business

In your business, too, there is doubtless a place for Presdwood. It comes in four foot boards, twelve feet long. It is also cut to special sizes at the mill. Generous samples gladly furnished. May we send the samples now?

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Sales Offices: Dept. 726 111 W. Washington St.
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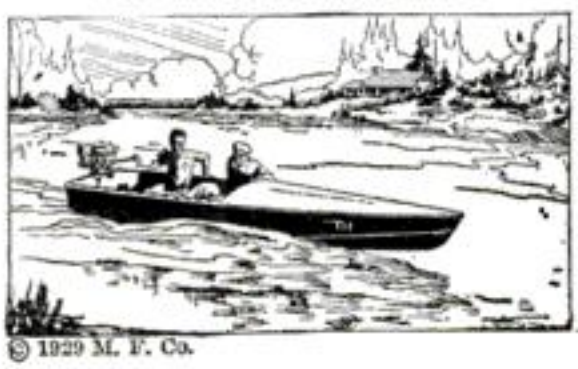

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Our Readers Say—

Is He Right?

"I HAVE been wondering for several months why a magazine like POPULAR SCIENCE MONTHLY should have gone out of its way to print such an insidiously harmful set of articles as 'I am Learning to Be a Flyer.' The Lindbergh ballyhoo and the rest of the recent uproar about aviation, it seems to me, have done enough to sow seeds of discontent in the minds of our youth without your deliberately appealing to their immature judgment by picturing a career in aviation in such rosy hues.

"Every half-baked youngster, too lazy or too frivolous to be interested in the serious things of life, who reads Larry Brent's stories, will say immediately, 'Ah, there's the life for me! No studying, no hard work, no responsibility; just a perpetual joy ride—and plenty of money for it! I'm going to be an aviator!'

"Isn't it difficult enough now to keep boys interested in their books and to make them realize that earning a living is a difficult, serious process, without your attempting to demonstrate that it's only a fool who works; that life can be made, if we choose, a sort of 'movie hero' proposition—just thrills, excitement, and a good time?

"Besides, aren't there enough wild kids running mad in automobiles without your wanting to get them up in the air as well?" —O.T.K., Poughkeepsie, N. Y.

It Went to Her Head

"R. R. C. states that man's brain is comparatively larger than that of any other animal. J. Arthur Thomson says that the man with the largest brain was a day laborer and the woman with the largest brain was feeble-minded." —E. C. H., Columbia, Mo.

Paus Tears His Hair

HERBERT PAUS, the artist who paints our covers, has about decided to forsake his easel and brushes and go in for a course in civil engineering. Ever since our April issue made its appearance, the mailman has been bringing choice messages like these:

"It is very evident that the artist for your April cover knew very little about engineering. The transit man is using one of the transit legs for a hand rest. The weight of one hand would cause a very distinct error."—H. M. S., Pittsburgh, Pa.

"I have been in civil engineering work about ten years, and I have yet to belong to a survey party that dressed as those fellows in the picture are dressed. They look like Boy Scouts." —P. I. C., Burlington, N. C.

"Have enjoyed the cover designs by Paus, but he has never worked on a surveying crew." —G. W. B., Cumberland, Md.

"All three of the boys in the pictures may become engineers, but they haven't started yet."—G. W. G., Lexington, Ky.

8,000-Mile Reception

"I WANT to thank POPULAR SCIENCE MONTHLY and the Institute of Standards for perfecting a radio set, and printing plans of same, which enabled me to construct a receiver which, after two years, I still declare to be the best I have yet operated. Two years ago I completed my first set—the POPULAR SCIENCE five-tube, and when I turned it on, the first station I logged was Calgary, Alberta, Can. I have been more than pleased ever since. With a few minor changes I have made, the set now has a receiving radius of 8,000 miles, verified logs."—E. G. B., Bremerton, Wash.

Signs of the Season

"EVERY spring, many people take the so-called 'spring tonic,' molasses and sulphur. I think your readers would be interested to learn the scientific grounds for this practice. If it be superstition, it ought to be exposed."—(Rev.) M. H., Newark, N. J.

What! No Grandfathers?

"W. E. C. writes he has figured out that each of us had millions of great-grandfathers and confesses his inability to solve the puzzle.

"Why, he plumb forgot that his granddaddy might have had two sons, not to mention daughters. Suppose we consider the world's present population to include 1,000,000,000 sons, and that for every two of these sons there was one father, and for every two of the fathers there was one grandfather, and so on. Then there must have been 500,000,000 fathers and 250,000,000 grandfathers, etc. Going back thus thirty generations of thirty years each, a total of 900 years, we find there was only one father left and no grandfathers at all!

"What they did for grandfathers before that is another puzzle.

"Presumably monkeys lived at that time, too."—H. V P., Arkansas Pass, Tex.

"W. E. C. inquires how it is that you have more grandparents that lived 6,660 years ago than there were people at that time. My answer is that there weren't. I think that when you get back seven or eight generations two or more of your grandparents are one and the same person."—E. C. H., Columbia, Mo.

Can You Assist?

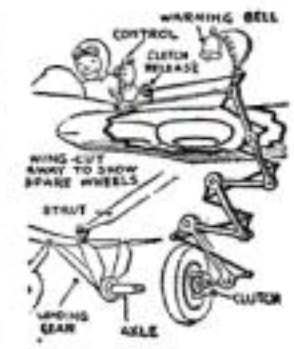
"SUSAN KOERNER WRIGHT, mother of the airplane inventors, was born in Hillsboro, Virginia, on April 30, 1831, according to John R. McMahon in his series on 'The Real Fathers of Flight' in your magazine. There are two places of that name in Virginia. Orville Wright himself has said he does not know in which one his mother was born.

"On account of the tribute paid to the inventors' mother by Mr. McMahon in his series, a movement has been launched in Virginia by Mrs. Elizabeth C. Grasty, of University, Va., to locate the birthplace definitely as between Hillsboro in Loudoun County and Hillsboro in Albemarle County, with a view to establishing a suitable memorial to one who finely developed and largely inspired her sons to their epochal discovery.'

"Perhaps some readers of POPULAR SCIENCE MONTHLY can assist in this search. If so, I would suggest that they send any information they may have or obtain to Mrs. Grasty."—S. L. D., Richmond, Va.

Lindy, Take Notice!

"EVERY once in a while I read in the papers where an aviator loses a wheel in the air and has a smash-up in landing, like Lindbergh did down in Mexico. Why doesn't someone try putting an auxiliary wheel on the axle, inside the struts, that would be a little smaller than the main wheel and would not touch the ground except in case of emergency?



"Recently you showed the picture of a motor bus with such an emergency wheel, to bear the weight of the machine when a tire blows out so the tire won't be injured. I don't see why the idea couldn't be applied to airplanes."—J. W., Richmond, Indiana.

Why They Read "P. S."

"I HAVE just read the letter of O. B. B. of Winfield, Kan., who wants to know why others read P. S. I read it so I can help my three boys to understand things they learn at school; also to interest them in the new problems."—Mrs. L. S., Belleville, Ill.

"I enjoy making things and am always waiting for the next issue to see what it has in store for me. It is through the influence of your magazine that I bought a home workshop."—R. J. M., Kingston, Pa.

"I read POPULAR SCIENCE because I am possessed with a real longing to create and construct."—G. S. N., Jr., Southern Pines, N. C.

"Your magazine is especially interesting to me because of the many articles on homes and house building."—G. C., Chicago.

"My work, ornamental iron, takes in both machine shop and blacksmith work. Your magazine gives many tips on machine work." —A. R., Jr., Marblehead, Mass.

What's the Answer?

"MY FRIENDS and I have noticed a strange phenomenon concerning the red and green street traffic lights.

When the red light is on, the shadow of an object in front of the colored light is green. When the green is on, the same shadow is red. A light from overhead illuminates the street. When the amber light is on, the shadow is black."—G. W. L., Kalamazoo, Mich.

What Do You Say?

"I BELIEVE many of your readers would welcome the extension of your page, 'Our Readers Say.' This is a very important part of your publication."—J. A. S., Jr., Patchogue, N. Y.

TENDER SKIN
HEAVY BEARD

TENDER SKIN
MEDIUM BEARD

TENDER SKIN
LIGHT BEARD

MEDIUM SKIN
HEAVY BEARD

MEDIUM SKIN
MEDIUM BEARD

MEDIUM SKIN
LIGHT BEARD

TOUGH SKIN
HEAVY BEARD

TOUGH SKIN
MEDIUM BEARD

TOUGH SKIN
LIGHT BEARD

Name your beard, Gentlemen

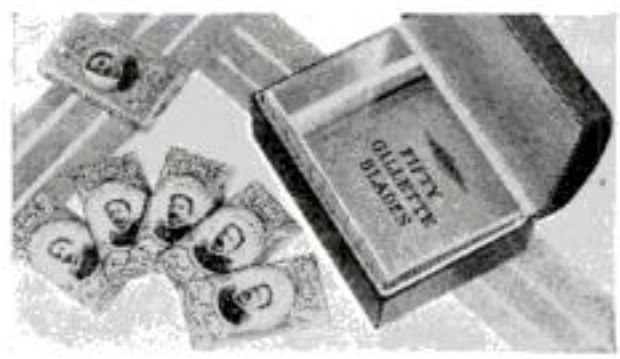
BEARDS are past reforming. Blue and bristly or blond and silken, they're all hard to shave—at least you can't tell their owners otherwise.

We don't try to.

It's easier to put the burden on the blade; to use the best and most expensive steel and to spend, as we have, some $12,000,000 in the past ten years to develop precise and delicate machines that hone and strop that fine steel far beyond the limits of human craftsmanship. It's easier to pay a bonus to workers for every blade they reject which does not come up to the high Gillette standard.

True, it makes some difference whether your beard is heavy or silken, your skin sensitive or tough; whether the water is hot or cold, hard or soft; whether you slept well or badly the night before.

But even under the worst possible conditions you can count on the Gillette Blade to do its job smoothly, surely and well. It's the one constant factor in your daily shave. Gillette Safety Razor Co., Boston, U. S. A.



THE NEW FIFTY-BOX. Fifty fresh double-edged Gillette Blades (10 packets of fives) in a colorful chest that will serve you afterward as a sturdy button box, cigarette box or jewel case. Ideal as a gift, too. $5.00 at your dealer's.

Gillette

★ **Gillette** ★

Happy in the knowledge of *year 'round comfort*

SMART young couples, nowadays, refuse to take chances with so important a matter as safeguarding their homes from extreme weather.

Especially since they know they can *make sure* of proper protection with Celotex insulation. They know that Celotex secures them against the attacks of heat, cold and illness . . . leaves them happy in the knowledge of *year 'round comfort.*

A constantly increasing number of people are obtaining greater home enjoyment through the use of Celotex. Already, more than 250,000 families are living in Celotex homes.

Despite its many remarkable properties, Celotex is a simple, practical insulating board.

It is made from long, tough fibres of southern cane. These fibres are felted into big, strong boards, 4 feet wide, 7 to 12 feet long and 7/16 of an inch thick. (Also made double-thick—7/8-inch.)

When used on the outside of houses, as sheathing, Celotex adds structural strength . . . makes walls tighter and more permanent.

And on inside walls and ceilings, you can obtain finer, smoother plastered surfaces with Celotex Lath. This new lath, 18 inches by 48 inches and 7/16 of an inch thick (also made double-thick —7/8-inch), is especially designed to reinforce against plaster cracks and eliminate lath marks.

As interior finish, Celotex adds new beauty to homes through its natural tan color and pleasing fibre texture.

Celotex is used in old homes as well as new; for insulating roofs; for lining basements, attics and garages; for making comfortable extra rooms from waste spaces.

As insulation, Celotex is not an expensive extra item, because it replaces other materials, and in later years saves you hundreds of dollars in fuel bills.

Ask your architect, builder or dealer for further information on Celotex—and send in the coupon below for our free booklet.

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CELOTEX
BRAND
INSULATING CANE BOARD

When you buy a new house, look for the Celotex sign. It is your assurance of greater home comfort.

Popular Science MONTHLY

JUNE, 1929 SUMNER BLOSSOM *Editor* VOL. 114, NO. 6

What happened to the *Cyclops*? For years the fate of the vanished Navy collier and her crew has been the subject of astonishing stories and speculations, as these many newspaper clippings testify.

Strangest American Sea Mystery Is Solved at Last

By ALFRED P. RECK

IN THE latter part of February, 1918, the U. S. S. *Cyclops*, naval collier, steamed out of the beautiful harbor of Rio de Janeiro, Brazil, with 309 persons on board. She rounded Sugar Loaf Island and headed northward for the open sea.

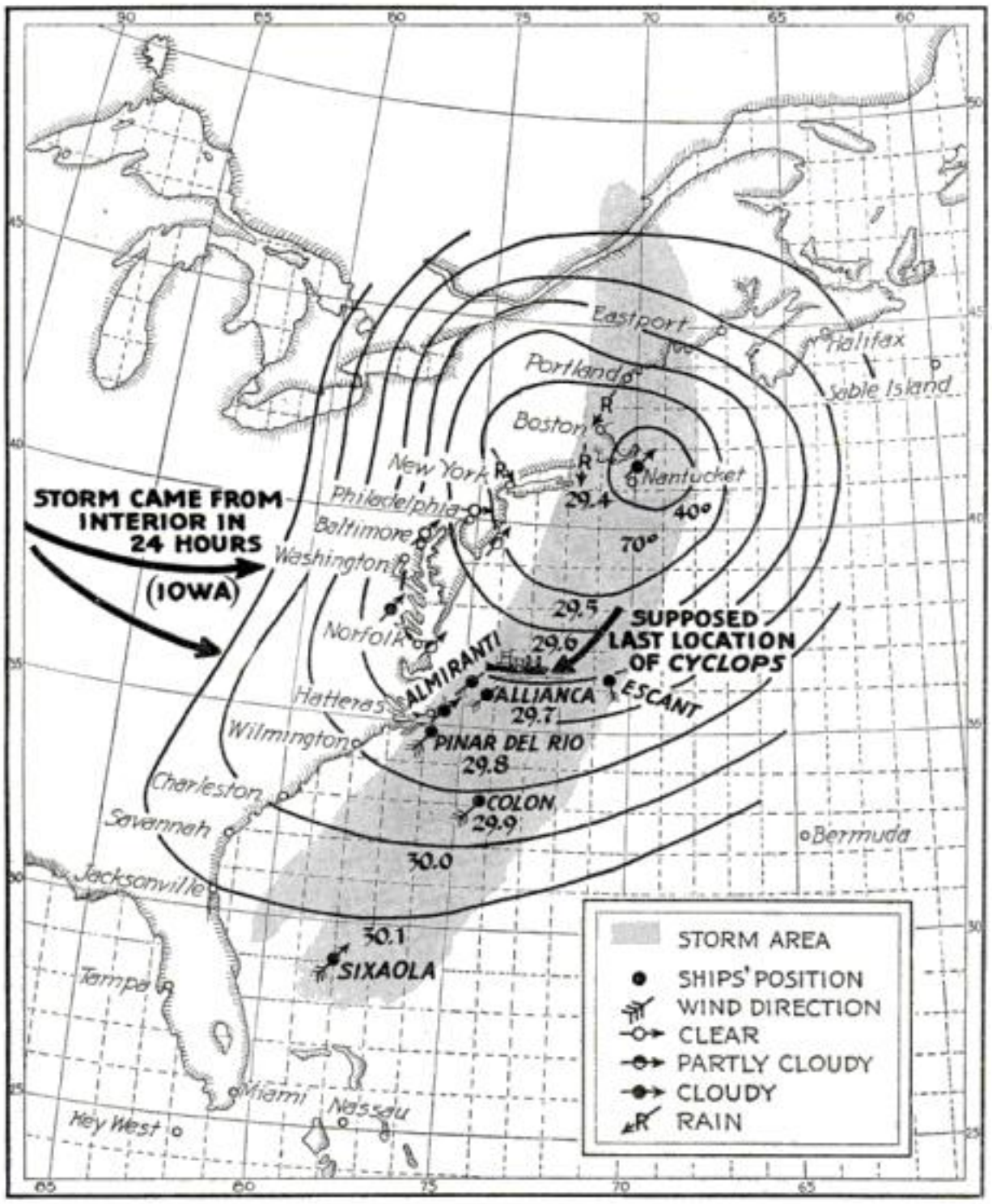
A few days later she put in at Barbados, British West Indies, for coal and provisions. Here she left on March 4 for the port of Baltimore.

On March 9, the collier passed the molasses tanker *Amalco* north of the Virginia Capes, only a short distance from her destination and almost in sight of the United States coast line.

Since that day, neither the *Cyclops* nor any of her 309 men has ever been seen or heard from.

There you have the bald, stark facts forming the barest outline of one of history's most baffling sea mysteries. Not one soul survived to tell what befell the hapless collier. Not one lifeboat was found bobbing helplessly on the waves to give a hint of the location of her grave. Not a single scrap of wreckage. The *Cyclops* disappeared as strangely and as suddenly as if the ocean had opened and swallowed her.

Those were seething days on land and sea, for the United States was at war with Germany. Had the *Cyclops* been cap-



The map, prepared especially for this article by the U. S. Weather Bureau from reports of vessels on March 10, 1918, shows storm which probably sank the *Cyclops*. Curved lines are barometer readings.

tured by a German raider, or had she been "sunk without a trace" by one of the swift and treacherous enemy submarines that was lurking off the coast for just such an opportunity?

On March 23 the collier was recorded as "missing." Naval vessels were dispatched on the search. Fruitless! They combed the waters from New York to Barbados without encountering as much as a bit of driftwood that might give a clue.

AMERICAN wireless stations, continually listening to intercept messages from enemy craft, heard no call for assistance. Radio queries swept the entire Atlantic, day and night, for ten days, but remained unanswered. All commercial vessels were requested to look out for wreckage that might indicate the fate of the *Cyclops*. Nothing was found!

Then American diplomatic agents abroad were instructed to seek information. German U-boats had been known to operate in the waters of the West Indies and the hulking naval vessel was a desirable and easy target for an enemy torpedo. No result!

Even the Imperial German navy itself was asked for news of the *Cyclops*. Wireless messages passing between the German naval headquarters and German submarines were intercepted and decoded. In vain! All U-boat commanders denied having seen the collier.

This intensive search was continued for exactly one hundred days after the *Cyclops* should have docked at Baltimore. Then she was officially marked "lost," and all on board her were recorded as dead. Navy men pronounced her disappearance one of the most impenetrable riddles of the sea.

But still the quest was not at an end. From then on, the investigation was continued "under cover." There was ample reason for secrecy. In the excitement of war days, when a slight foreign accent or the un-American spelling of a name were causes for suspicion, ugly rumors were circulated about the collier and its strange fate.

One of these stories involved the commander of the *Cyclops* in a charge of high treason. According to this report, there had been mutiny aboard the ship, which had been turned into a German raider by its own American captain!

As a matter of record, C. Ludlow Livingston, then American consul at Barbados, suggested this solution of the mystery in a confidential message to the Navy Department.

Livingston intimated that the master of the *Cyclops*, Lieut. Commander George W. Worley, of the U. S. Naval Reserves, who, though of German extraction, was an officer with a long and honorable record, had taken his ship and joined the German navy.

"Commander Worley was disliked by his officers and crew," the consul wrote. "Many called him a 'damned Dutchman.' While not having any definite grounds, I fear a fate worse than sinking, though possibly based on an instinctive dislike toward the master."

LIVINGSTON also intimated that there was no need for the stop-over in the West Indies, as the collier had plenty of fuel and provisions for the run to Baltimore. He suggested that the extra coal and food had been taken on board so the collier could steam direct to Germany.

What ghastly scenes had been enacted on that ship? And what kind of superman was Worley? The officers and crew disliked their "Dutch" master. How had he succeeded in subduing them and delivering his charge into enemy hands?

While the Navy Department was investigating this theory, it was thrown into excitement by a wireless from a secret agent abroad who reported that he had seen the *Cyclops* in the Kiel canal in Germany. This seemed to substantiate the Livingston story. But later it developed that the "*Cyclops*" which the agent had seen was not the missing collier but a German ship of the same name.

BUT the Department did not give up the search. It investigated a letter received about that time from a prisoner of war, who said he had talked to several members of the *Cyclops* crew who also were prisoners in a German camp.

Another report had it that the collier had been blown up by a German spy, who had secreted himself in the hold while she was coaling at Barbados.

At the close of the war the German navy records at Berlin were examined but failed to yield the key to the *Cyclops* mystery. In fact, German naval authorities informed the United States agents that all they knew about the collier was what they had gleaned from the American press!

But stubbornly the Government continued the inquiry. As late as 1922, fully four years after the disappearance of the vessel, Navy investigators were working on the "*Cyclops* case." At that time, a prisoner in a Philadelphia jail related a story told him by one John Gombold, who claimed to have served on a German submarine.

"OH, THE *Cyclops!*" Gombold was reported to have told his fellow-prisoner. "Sure, we sank her, with not so much as a bucket showing."

Gombold said the sinking took place thirty-eight miles off the coast of Cuba.

The Navy men also investigated the story of an engineer who told how he had constructed a huge undersea gun turret several miles from shore and connected with the mainland by a tunnel, which was used to blow up the *Cyclops* after it had been turned into a German raider.

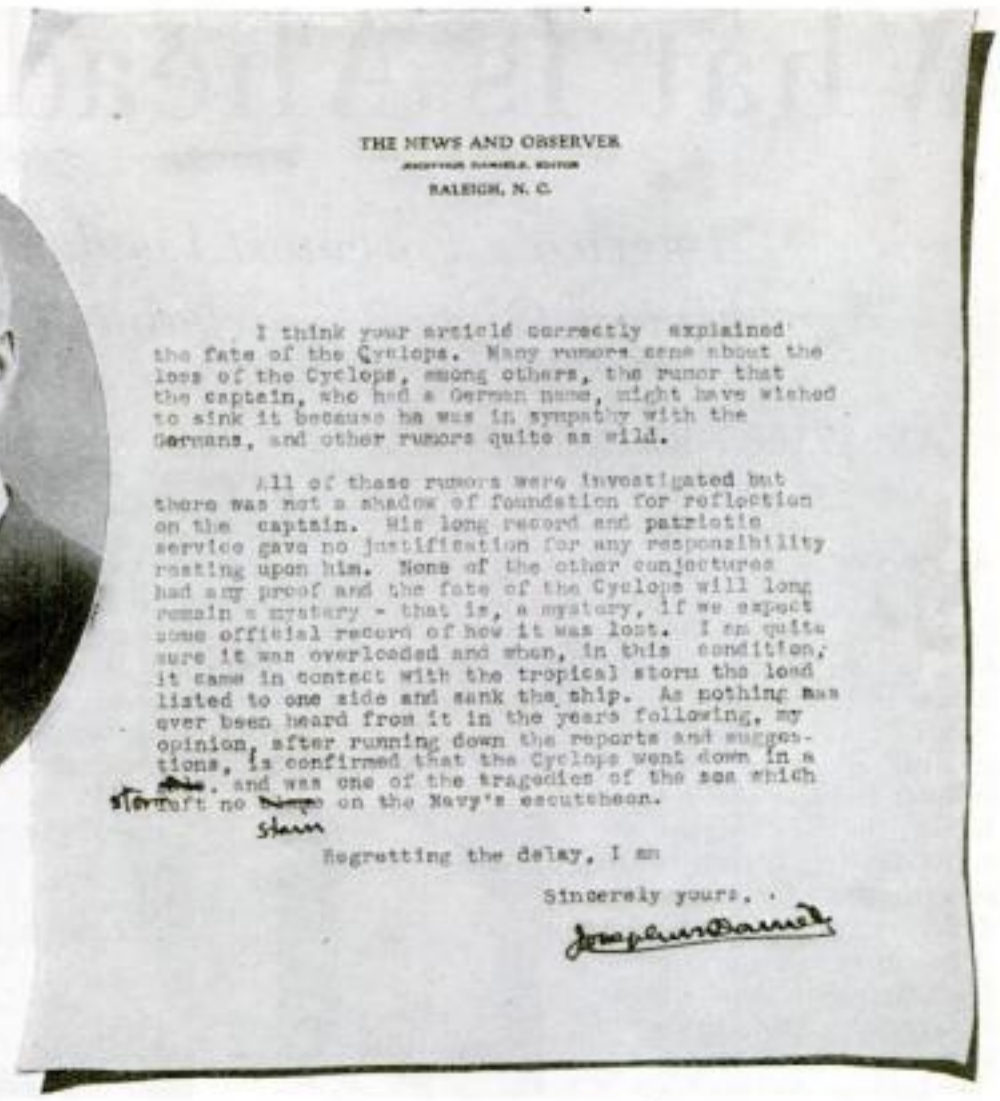
Every one of the stories proved unfounded! Even the dreams of mothers whose sons had been lost on the collier were investigated! All without result,

Not a scrap of evidence to support the suggestion made by Consul Livingston. Nothing to support in the slightest way any of the "1,001" other rumors. Then the records were stored away in the vaults of the Intelligence Bureau and the case was dropped. Thereafter, all official information issued by the Navy Department proclaimed the disappearance of the *Cyclops* an "unsolved mystery of the sea."

Unsolved, yes; but—insoluble?

ELEVEN years ago, when the collier vanished, the mystery intrigued me, and the possibility of solving this weird riddle of the seas has fascinated me ever since. What really did happen to the *Cyclops*? The ship did not dissolve into thin air. No modern counterpart of the Lorelei drew her to the bottom of the ocean with the irresistible lure of her siren song. There must have been natural and logical causes for her apparently inexplicable disappearance. I was determined to find out what they were.

Josephus Daniels, Secretary of the Navy at the time the *Cyclops* disappeared in 1918. At right: A facsimile of part of a recent letter, in which he expressed belief that the facts presented in the accompanying article correctly explained the fate of the collier *Cyclops*.



THE NEWS AND OBSERVER

RALEIGH, N. C.

I think your article correctly explained the fate of the Cyclops. Many rumors arose about the loss of the Cyclops, among others, the rumor that the captain, who had a German name, might have wished to sink it because he was in sympathy with the Germans, and other rumors quite as wild.

All of these rumors were investigated but there was not a shadow of foundation for reflection on the captain. His long record and patriotic service gave no justification for any responsibility resting upon him. None of the other conjectures had any proof and the fate of the Cyclops will long remain a mystery - that is, a mystery, if we expect some official record of how it was lost. I am quite sure it was overloaded and when, in this condition, it came in contact with the tropical storm the load listed to one side and sank the ship. As nothing has ever been heard from it in the years following, my opinion, after running down the reports and suggestions, is confirmed that the Cyclops went down in a storm, and was one of the tragedies of the sea which left no stain on the Navy's escutcheon.

Regretting the delay, I am

Sincerely yours,

Josephus Daniels

Recently, the official records of the *Cyclops* contained in the war-time files of the Navy Department were placed at my disposal. In the quiet of the naval library at Washington, I carefully studied and sifted—the facts! And step by step, I was able to follow, in imagination, the fatal course of the *Cyclops* from the day she steamed out of Rio de Janeiro until March 10, 1918—the day after the molasses tanker *Amalco* passed her north of the Virginia Capes!

What are the facts?

First of all, the *Cyclops* was an awkward craft. Built as a naval collier, she had nearly as much machinery above decks as below. There were huge cranes to swing her cargo to waiting battleships, and towering steel beams which guided the hoisting elevators. She was a large ship, but ungraceful.

On her fatal voyage, the collier was not operating directly in the naval service, but was carrying war-time freight at so much per ton. She was en route from Brazil to Baltimore with a cargo of manganese ore, used in the manufacture of munitions. What I found in the records was that the *Cyclops*, on her last trip, was loaded with 10,800 tons of the ore—much more than the safe capacity of the vessel. The manganese had been poured into her hold without apparent regard for maximum weight. As a result, when she left Rio de Janeiro, even in the quiet waters of the harbor, the seas lapped dangerously near her Plimsoll, or safety, mark.

A report to the Navy Department following an investigation by the commander-in-chief of the Pacific Fleet, to which the *Cyclops* had been attached, was particularly significant in this connection. A portion of it read:

" . . . 10,835 tons of manganese stowed direct on wood dunnage in bottom of hold. Reports differ as to whether cargo was trimmed level or left somewhat higher in the middle. Inclined to latter belief. Vessel also had 4,000 tons of water, mostly in double bottom. So far as ascertained no steps taken to prevent increasing of metacentric height (governing top-heaviness), and this must have been considerably increased."

The conclusion reached at the close of this report was that "sudden shifting of cargo caused her to capsize and to be instantly engulfed."

The maximum dead weight of the *Cyclops* was 14,500 tons. Her cargo capacity was listed as 8,000 tons of coal. With the 10,000 tons of manganese on board, the 4,000 tons of water and, in addition, fuel coal and provisions taken on at Barbados, there can be no doubt that the collier was heavily overloaded.

At the West Indian port, where the *Cyclops* put in a few days after leaving Rio de Janeiro, officials reported that the water line was over the Plimsoll mark when the collier steamed northward.

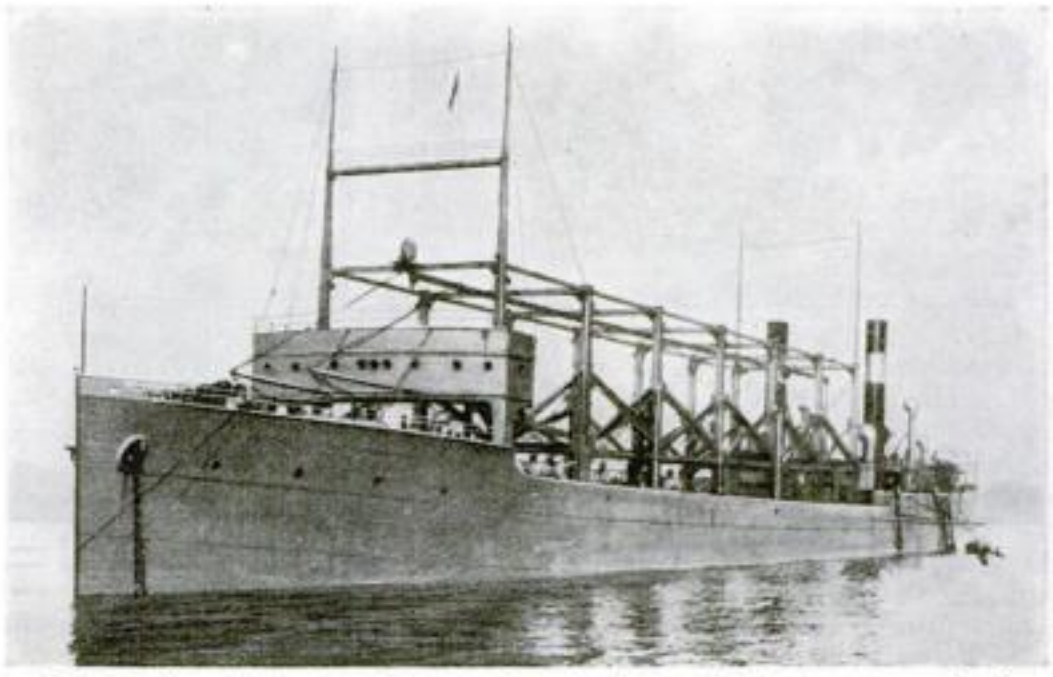
SO MUCH for the cargo. But that wasn't all. In the records were several significant reports by Commander Worley, written prior to the collier's last voyage. In one, the master said the starboard engine was out of commission with a cracked cylinder, and charged a junior engineering officer with neglect. He intimated that the officer would face a court of inquiry as soon as the ship reached an American port.

This complaint of the commander was substantiated by a survey board which inspected the engines at Rio de Janeiro and reported them "not in satisfactory condition." However, the board recommended that repairs be postponed until the collier completed her trip.

Then, too, Commander Worley wrote to the Bureau of Operations of the Navy Department, complaining about the quality of his crew and personnel.

Upon America's entry into the World War, the Navy made stirring appeals for recruits. A host of young fellows full of

(Continued on page 137)



One of the last photos of the *Cyclops*. Her capacity was listed as 8,000 tons of coal. On her fateful voyage she carried 10,000 tons of manganese and 4,000 tons of water.

What Is Ahead in Aviation

America's Foremost Leaders in Many Branches of Flying Give Remarkable Forecasts of the Future

W. E. Boeing. "Overhead landing fields are coming."

Igor I. Sikorsky. "Giant flying ships for Atlantic travel."

Grover Loening. "Revolutionary new planes must come."

SHALL we soon fly our own planes as easily as we now drive motor cars? Shall we go by air in passenger ships as safely and comfortably as we now travel by train? Questions like these come from our readers every day. To answer them, POPULAR SCIENCE MONTHLY asked some of America's foremost aviation experts what they believe the future holds. Their replies give a fascinating picture of progress.

Charles L. Lawrance. "Motorists will fly within three years."

Glenn H. Curtiss. "A wonderful future for the flying boat."

Orville Wright. "Aviation has gone beyond my dreams."

AMAZING RECORDS

ORVILLE WRIGHT
Co-inventor of the Airplane

NO ONE could have foreseen, and I myself never expected, the tremendous development of aviation at the present time. Airplanes are safer than ever before; they are finding applications beyond my most hopeful dreams; and the new records that are daily established are an outstanding tribute to the performance of the modern plane.

By way of example, I recall an altitude flight that I made in Germany not so many years ago. Flying over a captive balloon tethered on a steel cord—barographs then were unknown—I made a mark of something less than 600 feet. Today the altitude record is more than seven miles!

Flying today, I miss the thrill of the rickety planes we used to use—but I am convinced that the cabin type of plane is best suited to the high speeds of modern aviation. No air traveler today is anxious to put up with the inconvenience of a stinging wind in an open cockpit.

I do not believe, despite aviation's great advance, that the day of the "flivver" plane for every family is immediately at hand, if for no other reason than the considerable space that airplanes require to land and to take off. — *As told in an interview especially for* POPULAR SCIENCE MONTHLY.

NEW DESIGNS

GROVER LOENING
Consulting Aeronautical Engineer

FURTHER advances in aviation seem quite definitely to be tending toward the departure from the design of the original Wright invention of the airplane with fixed wing and propeller-driven, as we know it. There has not been any really successful improvement on this design since the Wrights flew twenty-five years ago.

While there have been many interesting developments, such as the slotted wing and the autogiro, and interesting as the progress has been in giving this invention more power, speed, and load-carrying capacity, there has been an entire failure to improve its safety by enabling the airplane to land in smaller areas. The most striking evidence of this is that, twenty-five years after the Wrights' first flight, no modern 1928 airplane was able to land or take off on the field from which the original flights were made.

The airplane has other inherent dangers which have not seriously been gotten away from. Inventive minds all over the world are beginning to realize these limitations and fundamental dangers.

It will not be long before a new method of carrying loads at high speeds in heavier-than-air craft will be developed. An increasing number of engineers and scientists are beginning to agree with Mr. Edison that the airplane, as we know it, is not so practical at all, is inherently dangerous, and is not likely to be the heavier-than-air vehicle that will bring on the real Air Age.

FLYING BOATS

GLENN H. CURTISS
Inventor of Hydro-Airplane and Flying Boat

AVIATION is no doubt due for great advances in every field of travel, but in my opinion we may look for the greatest relative advance over present methods of travel in oversea transportation.

A good flying boat is very seaworthy, and forced landings, although they are becoming fewer in number each year as aviation advances, will not be as serious to contemplate when flying over water.

A rough sea, of course, presents some risk at times, but a rough sea is usually accompanied by a wind which will enable the plane to make a slow landing. A forward speed of twenty miles or less per hour is quite likely. It must be remembered that a seaplane afloat on the water automatically heads into the wind, and with the lifting action of the wind on the wings, the pontoons will ride the waves with great buoyancy and steadiness.

With a good sea anchor, it would be possible for the wind to lift a light plane clear of the water. I mention this to show the action of the wind on a seaplane or flying boat, adrift.

There is, in my opinion, a wonderful field for endeavor in large flying boats.

AIRSHIPS

LIEUT. COMMANDER C. E. ROSENDAHL
Commanding Officer, Los Angeles

THE rigid airship will occupy a definite place in the realm of aerial transportation, both naval and commercial. It will be equal to any except the most severe weather conditions, which it will avoid. Efficient and reliable, its particular field will be transoceanic.

American airships will be among the foremost aerial carriers of the world. Some of their outstanding features will be:

The use of helium for inflation.

Multiple heavy-oil power plants located within the hull.

Swiveling propellers for vertical thrust as well as fore-and-aft propulsion.

Eventual cruising speed of 100 miles an hour.

William A. Moffett. "Merchant marine of the air."

C. M. Keys. "The cost of flying is being reduced."

J. H. Dellinger. "Radio will conquer hazards of weather."

C. E. Rosendahl. "Greater airships for ocean travel."

F. B. Rentschler. "Passenger service a sound business."

Harris M. Hananue. "Transcontinental service in 24 hours."

Size increased by gradual increments to more than ten million cubic feet.

Such ships of the future will carry airplanes as auxiliaries, just as surface craft may. In shape they will be more blunt than at present. Their strength will be increased several fold, and multiple longitudinal corridors will serve also as strength members. They will have increased travel comforts and luxuries equal to the best furnished by any type carrier, and highly improved navigational facilities, with solution of the fog problem.

We are now on the threshold of obtaining these improvements. With the limited ships and facilities available for experimentation, progress is necessarily slow. But the airship is destined to become prominent and indispensable in the air.

RELIABILITY

MAJ. GEN. J. E. FECHET
Chief, U. S. Army Air Corps

AS A rapid means of transportation and communication, aviation has arrived. The technique of airplane and aeronautical engine design has given us flying equipment with worth while performance, with every indication that progress will continue—how far no one can tell.

Looking into the future, it seems to me that the most important development is going to be along the line of increased reliability and safety. Multi-engined transport planes capable of flying with one or more engines cut out, with arrangements for dumping part of the fuel load as an additional safety factor, operating over well organized airways, will furnish to the world a mode of transportation fully as safe as the present means of terrestrial transportation, and in many ways more attractive. Every day finds us a step nearer the goal of reliability and safety, a bit closer to the time when air transportation will take its place, not as a replacement for, but as a complement to, travel by railroad and automobile.

The field of military aviation is rather a separate thing. In that phase of aviation, performance is the goal, and present indications seem to point to substantial developments which will lead to marked improvement in performance.

NAVAL AVIATION

REAR ADMIRAL WILLIAM A. MOFFETT
Chief of Bureau of Aeronautics, U. S. Navy

AVIATION in the Navy and as part of the Navy will continue to be more and more useful and important, since improved design is constantly making aircraft more valuable.

After the war the Navy had only war type flying boats. Today we have about 850 modern planes.

Three carriers are in commission and the two new ones carry and operate nearly one hundred planes each. A new carrier of 13,800 tons has just been authorized by Congress and will be begun this year. Four additional carriers of the same size will undoubtedly be appropriated for and built within the next few years. There will, in time, be many more carriers in the Navy than those we have today and those proposed.

All cruisers and battleships have been fitted with catapults and carry airplanes. The Navy will put aircraft ultimately on board all types of vessels, including submarines, destroyers, and tankers. In time of war, merchant ships, also, will be fitted with catapults and will carry airplanes for defense and offense.

The Navy's two 6,500,000-cubic-foot airships will be completed within the next four years, and they will be followed by more and larger rigid airships—the next one probably of about 10,000,000 cubic feet. These mammoth airships will be built by commercial concerns and will be used for the rapid transportation of mail, express, and passengers across oceans, both east and west and to the south. We will have a merchant marine of the air, just as we should have a merchant marine of the sea inferior to none.

TRANSPORTATION

W. E. BOEING
Chairman of Board, United Aircraft and Transport Corporation

THE industry is preparing to link major cities with regular, dependable passenger service which will be operated independently of the mail service, without the subsidy given companies in foreign countries. Passenger transports will be larger, faster, and more comfortable than were dreamed of a few years ago.

Transports carrying eighteen to fifty people are being built. Dining room service is now offered on some European lines and transports with sleeping berths are only a stride in the future. Overhead landing fields in business districts will be useful when commercial planes adopt the modification of landing gear which now permits naval planes to land on ships' decks. Airplanes with operating schedules of 150 miles an hour are in the minds of conservative aeronautical engineers.

It is safe to predict that within a few years every city of 50,000 people will have air mail service, and that all first-class mail between certain cities will be carried by air, with several inter-city schedules a day instead of one as at present. Air mail and transport service to Canada and our neighbor republics in Central and South America will stimulate commerce, help obliterate boundaries and hasten more harmonious international relations.

PRIVATE PLANES

CHARLES L. LAWRANCE
President, Wright Aeronautical Corporation

THE last year in aviation has been characterized by a very marked increase in the number of privately owned airplanes. From information I have received from various manufacturers of aircraft I am led to believe that the use of planes by private owners will greatly increase during the coming year.

Only several *(Continued on page 124)*

John F. O'Ryan. "Nonexplosive fuel to replace gasoline."

Edward P. Warner. "Flying in fog will be commonplace."

J. E. Fechet. "Every day brings greater reliability."

Edward A. Stinson. "Demand for flivver planes must be met."

Alexander Klemin. "Future plane will be a flying wing."

C. S. ("Casey") Jones. "Motorless planes may be possible."

The Speediest Craft Afloat

How Gar Wood Gambled with Death to Pilot His Frail Speed Boat Ninety-Four Miles an Hour—"Just for Fun"

By ROBERT E. MARTIN

NINETY-FOUR miles an hour! Fast enough in the air—hair-raising on land—but so speedy in the water that only one craft in the world has accomplished it. It is the world's record just made by Gar Wood, dean of American power boat racers, in his specially-designed *Miss America VII*.

Spectators crowded the shore of Indian Creek, a narrow salt-water arm between Biscayne Bay, Florida, and the sea, the other day. They saw an aquatic projectile rocket six times up and down a mile-long course. It spat flames from its exhaust, and passed with a noise like that of a fleet of airplanes. In the stern crouched Gar Wood, gripping a steering wheel.

"Best mile, 94.12 miles an hour!" announced Otis A. Porter, timer of every important race in America, when the last of the required six heats was run. "Average in statute miles for the six trips, 93.123 miles an hour!" Gar Wood had eclipsed by a fraction of a mile the two records his brother George set last September—93.722 miles an hour for the best mile, and for the six-heat average, 92.838 miles an hour.

The victory was a pleasant aftermath to a disappointing race. Less than a week before, at Biscayne Bay, Wood had pitted his *Miss America VII* against the craft *Miss England* piloted by Major H. O. D. Segrave.

That doughty Britisher had just broken all records by piloting an automobile over Florida sands at the astounding pace of 231 miles an hour, and now sought to annex speed boat laurels as well. A few minutes after the start, an accident put Wood out of the race. He was speeding at sixty-four miles an hour, leading by twelve lengths at a turn, when his steering gear snapped. Segrave finished alone, and automatically won the contest.

THE Indian Creek race against time was a vindication of Gar Wood's boat. His ninety-four-mile-an-hour record was all the more remarkable in that it was made on salt water. Old hands at power boat racing foresee a still faster mark when the craft is taken to Detroit this summer and run on a fresh-water course.

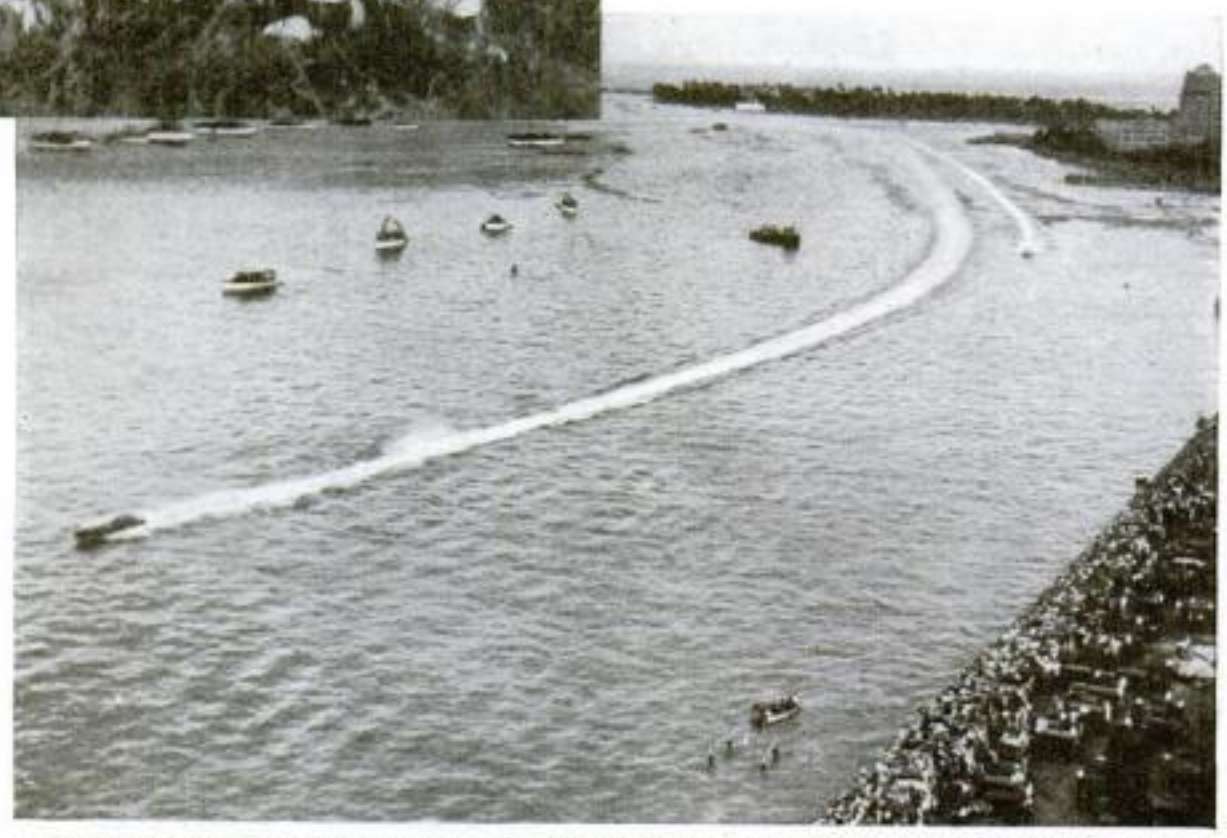
It was at Detroit that George Wood, brother of Gar, made last September's record; and there I received my introduction to the famous *Miss America VII* and to Gar Wood, her equally famous builder. From the deck of a Coast Guard cutter swinging at anchor in the Detroit River I had witnessed the speed dash—a blur of two white-robed figures, smoke, and spurts of flame. Now the water champion lay at anchor after the race against time, swells lapping her sides and her two twelve-cylinder motors still smoking.

She is just a fair-sized motor boat in dimensions—a twenty-eight-foot, "single-step hydroplane" whose bottom ends abruptly, halfway astern, to continue on a plane eight inches higher out of the water. The pilot sits in the stern, grasping a wheel that steers the boat by a little duralumin flipper—located not at the stern, as you would expect, but amidships under the hull.

The mechanic sits at the pilot's side during the race, hunched over, gripping the throttles. Because he operates the engines, he is actually more the boss of the boat than the pilot, who has plenty to do merely to keep the racer on its course.

IMAGINE the power of two thousand horses driving a craft no bigger than a ship's dory, and many times as fragile! No wonder the river of gasoline that pours into its carburetors is twice as great as that which feeds the motors of Gar Wood's seventy-foot gasoline yacht, at full speed. Looking at the pair of Packard aviation engines, iron brutes side by side, I noticed that two spark plugs for each of the twenty-four cylinders make ignition certain. Each of the V-shaped motors is rated at eight hundred horsepower; actually, though, they develop a thousand horsepower apiece.

I had expected that under the impulse of these mammoths, the *Miss America VII* would rise out of the water, nose first, at full speed. She hadn't, and now I saw that her entire weight is supported on the lower front plane. The boat skims along on her nose, the back half out of water.



Airplane view of the recent race between Gar Wood's *Miss America VII* and Maj. H. O. D. Segrave's craft, *Miss England*. The American boat is seen far in the lead, shortly before a broken steering gear put her out of the contest. Above: Wood (left) and Segrave shake hands before the start.

"Our problem," a voice at my elbow said, "is to move the boat forward with the least possible disturbance of the water."

I turned to a rather slight man of middle age with a thatch of unruly, thick gray hair—and garbed in a white coverall suit. He was Gar Wood.

There was one question I wanted to ask him. "The *Miss America VII* gave a wonderful performance," I said. "But I am curious to know why you let your brother drive your boat to a new world's record."

"THAT'S an easy one," Gar Wood replied. "George has been driving a year-old boat, the *Miss America V*, around in the other races during the last four days, and taking my boat's wash. I thought he ought to have a little of the glory. George is the salt of the earth, that boy!"

That remark of Wood's epitomizes the sportsmanship of a man who has spent $75,000 on the world's fastest water craft in order to drive her perhaps a dozen hours during her life of two or three years—and then to consign her to the scrap heap in favor of a faster boat. The *Miss America VII* that has just raced to a new speed mark in Florida is just what her name indicates—the seventh of a line of *Miss Americas*, the first of which Wood built in 1919 and used to win the Harmsworth international trophy in a thirty-mile race off the Isle of Wight. Since then he has successfully defended it against all challengers.

Power boat racing calls for a heart of steel and arms of whipcord. Gar Wood and his brother have both, though neither of them tips the scales at a hundred and fifty pounds.

Gar has had narrow escapes from death. In the Gold Cup race three years ago, his *Baby Gar*, speeding along the Detroit River at a sixty-mile clip, hit a piece of driftwood. Driver and boat sank instantly in ninety feet of water. Wood came to the surface unconscious. The two motors and the wrecked hull were never found, although the river was dragged for them.

Pilots and mechanics of speed boats always wear a special type of life preserver, often with a ruff around the neck to protect the throat, and guards for the arms and legs. Being thrown out and striking the water at ninety miles an hour is just like hitting a cement wall at that speed.

WHENEVER Wood builds a new boat he tests it himself. "The man who designs and supervises the building of a boat should be the man to test it first," he says, and this philosophy involved him in his most spectacular wreck.

Last summer he built the *Miss America VI* to defend the Harmsworth trophy against the challenge of Marian Barbara Carstairs, London owner of the *Miss Estelle II*, which later sank. On August twelfth he took his boat for a trial spin.

"I had worked darn hard for years, so I decided to play with boats." Here is Gar Wood at the wheel of his record-breaking speed marvel that has traveled more than ninety-four miles an hour. Orlin Johnson, his mechanic, sits beside him, as in all his races.

Imagine the power of 2,000 horses driving a craft no bigger than a ship's dory, and twice as fragile—and you have Wood's *Miss America VII*.

At a speed which some observers estimated at 100 miles an hour, the whole front half of the craft went to pieces. It had not been built strong enough to stand the strain.

Wood and his mechanic, Orlin Johnson, were swallowed in the water that engulfed the craft, and Wood was pulled down by its suction. He reappeared in a jumble of floating wreckage, none the worse for his shaking up. "I sort of figured she would have to be redesigned from the bottom up," he recalled having decided as he was floating to the surface in the midst of broken woodwork.

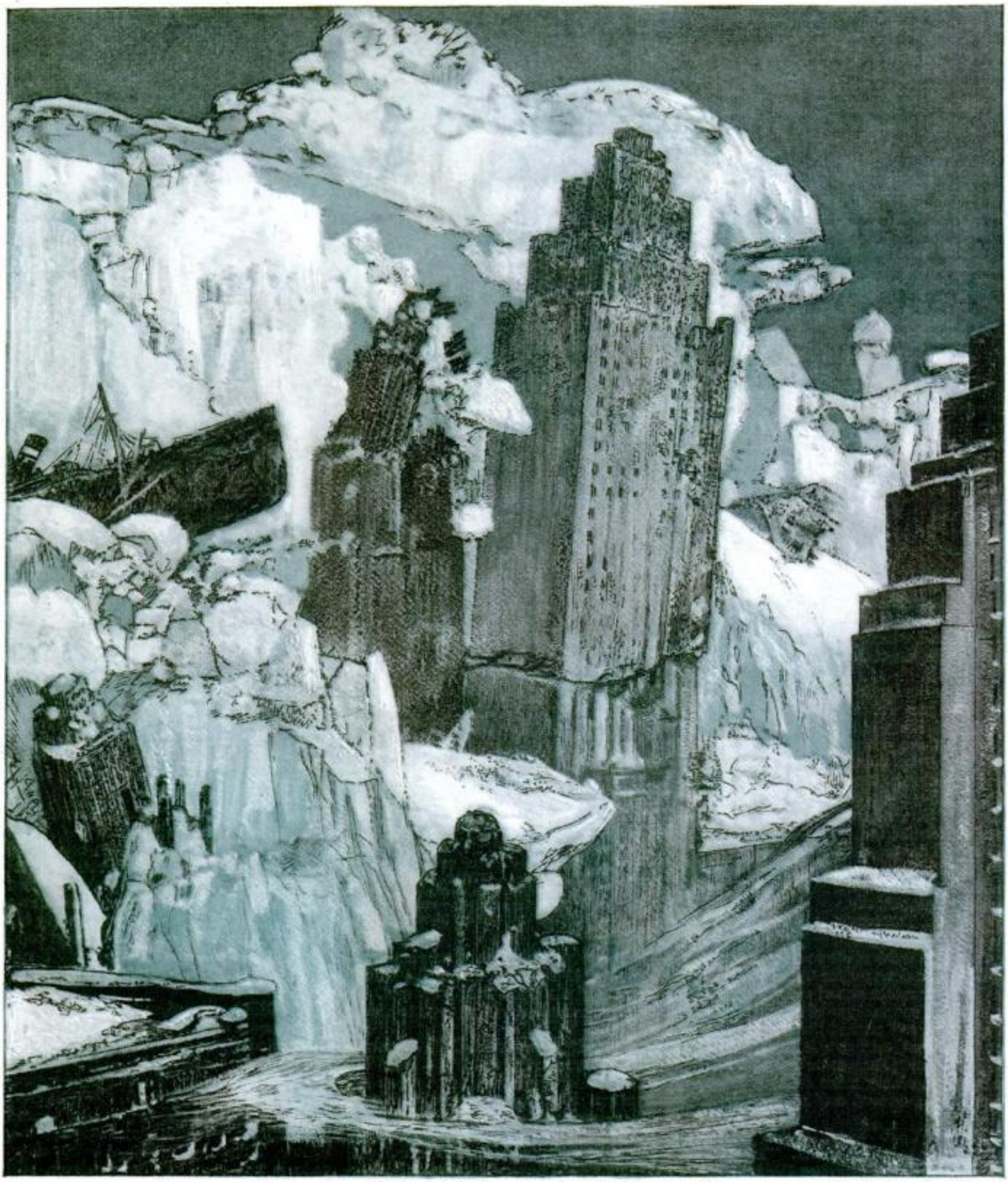
Johnson's jaw was broken and his cheek and throat so badly cut that his death seemed certain. He was insensible when fished out of the water and put aboard the Wood yacht, and regained consciousness in a Detroit hospital just in time to hear the surgeon say, "We can sew his wounds up, but it will be useless. He'll be dead within an hour." To which Johnson murmured, "The heck I will!"

The sunken boat had been months in building. It looked as if Wood had lost his chance to retain the trophy. But that night he put twenty-two men to work on a new hull. In two weeks from the day the old boat sank he had the new one completed, powered by the *America VI* motors, fished from the river.

THERE was no time to tune the *Miss America VII*, the new craft, for it was completed only three days before the Harmsworth trophy race. After winning this race, in which the Englishwoman's boat sank in the first heat, the trim craft raced three days later to its world's speed mark. And on both occasions the mechanic, Johnson, far from being dead, rode in the stern of the speedster, still bearing the scars of his accident.

Wood loves the water. Besides his two *Miss Americas* still running, he has a sedan-top runabout that can speed at forty-five miles an hour, as well as a fifty-foot cruiser and a seventy-foot yacht, both of which can give it a good race. For his twelve-year-old son he has built an outboard, a small-sized duplicate of the *Miss Americas*. (Continued on page 146)

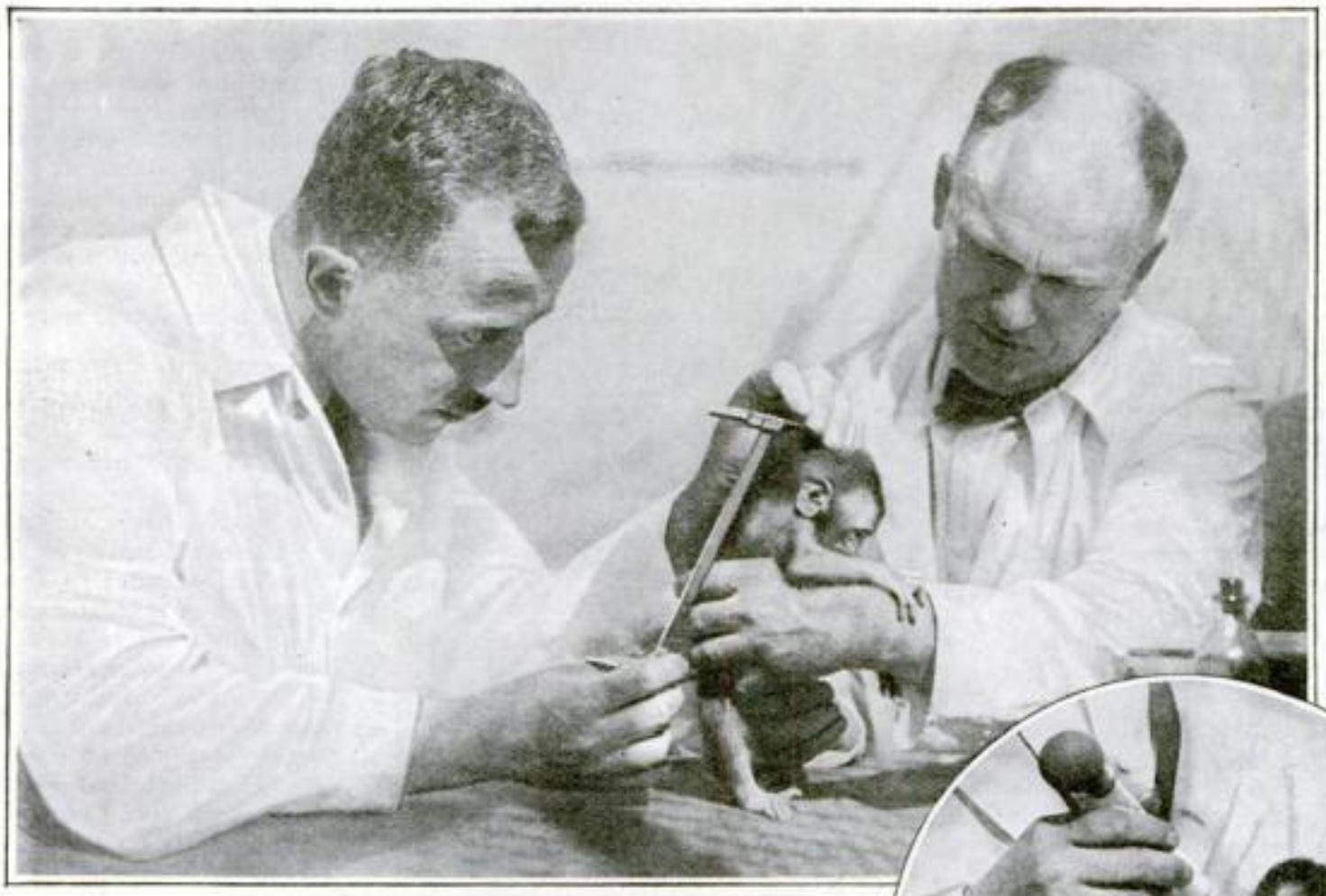
A New Ice Age May Bury Us



Skyscrapers topple as a crushing wall of ice sweeps down upon a great city. A dramatic portrayal of the next Ice Age, painted especially for POPULAR SCIENCE MONTHLY by Charles S. Chapman.

FROM Alaska and Greenland come wire flashes that great bodies of ice have been sighted moving slowly, inexorably southward. Polar auroras of dazzling colors are seen over Chicago and Seattle. Canada is already a frozen waste, swept by howling sub-zero gales. New York is fast becoming a deserted city. Its occupants are emigrating toward the equator to set up new homes and offices and factories in what was once tropical jungle.

Like a straw the Woolworth Tower and other skyscrapers topple before the creeping ice sheet. Special trains rush southward, crowded to capacity. Passengers in the last few, icebound in New Jersey and Kansas, are rescued by ski-fitted airplanes from Miami and sent hastening on their way. Soon only a few inhabitants are left in (Continued on page 157)



Taking the measurements of a week-old monkey—one of the animals reared to serve mankind in laboratory experiments with diseases that baffle science.

Modern Noah's Ark Fights Disease

By HENRY MORTON ROBINSON

Mealtime for the baby monkey. The little fellow is nursed as carefully as a human baby.

THE annual antivivisection bills are up again! In the assembly chambers of twenty states, legislators are once more debating the perennial question:

"Shall science be allowed to perform laboratory experiments upon living animals?"

And such a debate! An excited antivivisectionist member leaps to his feet and tells grisly tales of animals strapped to torture tables, ruthlessly butchered without anesthesia, and permitted to die lingering deaths as the result of wanton cruelty and neglect at the hands of medical experimenters.

In rebuttal, an equally excited vivisectionist flatly states that if science is to continue its successful warfare against disease, laboratory experiments with dumb animals must go on. He points to brilliant victories over such scourges as diphtheria, lockjaw, smallpox, diabetes, typhoid, and yellow fever, made possible only by patient experiments upon members of the animal kingdom. He brands the opponents of vivisection as enemies of scientific progress, and quotes the opinions of Dr. Alexis Carrel, Professor John Dewey, and Dr. Simon Flexner—three eminent scientists who stoutly maintain that vivisectionist methods are absolutely necessary in the war of science against disease.

Which side is right?

I determined to probe the whole matter of vivisection and find the answer. Being both a lover of animals and a staunch advocate of scientific methods, and having interviewed prominent spokesmen of the *anti* camp, I resolved to question the leading vivisectionists of the age. And above all, I wanted to see with my own eyes some typical experiments upon living animals, performed by skilled surgeons, in a great research laboratory.

Dr. Simon Flexner, Director of the Rockefeller Institute for Medical Research and its queer "Zoo."

My quest inevitably led me to the Rockefeller Institute for Medical Research in New York City, the largest and best equipped medical laboratory in the world. There are, to be sure, other famous laboratories where vivisection is practiced—notably at Johns Hopkins and Harvard Universities—but the fame of the Rockefeller "zoo" and the fact that such internationally celebrated surgeons as Dr. Carrel and Dr. Flexner direct the experiments made the Institute the logical scene of my investigation.

AS I entered the main gate I put myself in the neutral, open-minded position of the scientific fact-finder. I had already interviewed Mrs. Diana Belais, President of the Women's League against Vivisection, who had pointed out to me the services that dogs had rendered in the World War, claiming that their record of courage should exempt them from further service in the scientific laboratory.

I had listened to the sincere protests of Dr. Wilbur Murphy, eminent veterinarian, pleading against the practices of scientists in poisoning, drowning, and dissecting cats, dogs, and monkeys. But I had determined to hear both sides of the story, and it was in this impartial spirit that I laid my problem before Dr. Flexner, director of the Institute.

"I'm going to let the animals in our zoo answer all your questions," smiled Dr. Flexner. Without further explanation he led me into the "Animal House"—a veritable Noah's Ark of Science, located underneath the Institute. Here, in a maze of cages, pens, and stables, I saw the queerest and liveliest collection of animals ever gathered for the purpose of combating human ills. And I began to understand the important rôle animals are playing in the life and death battle between science and disease.

LET me show you just how some of them are doing it:

Take this tier of specially imported ring-tailed monkeys. These grinning little animals, because of their resemblance to human beings, provide the Institute doctors with the choicest material for advanced experiments with meningitis and sleeping sickness, two diseases that still baffle science. Without these monkeys it would be impossible to obtain experimental knowledge of two stubborn medical mysteries. Meningitis, a disease of the human brain and spinal cord, usually is artificially induced in the animals. Each ill monkey then is isolated. His spinal fluid is analyzed, his blood corpuscles counted, his temperature, behavior, and reaction to drugs are carefully noted. Everything that can be done to bring him back to health is attempted by the Rockefeller doctors, and the results are scientifically tabulated.

If he dies, the experiment enters its second stage. Cross-sections of the monkey's brain and spinal cord are placed under a high-powered microscope, and compared with normal tissues. Dr. Flexner, who is himself working on meningitis, informed me that whatever progress has been made towards a solution of the disease was due chiefly to recent experiments with these "Rockefeller ring-tails."

Look at this trio of blooded mares!

Dr. Alexis Carrel, Nobel Prize winner, famous for surgical discoveries made possible through his amazing experiments with dumb animals.

From their arteries, several pints of diphtheria antitoxin are obtained every month. The antitoxin, made from mare's blood, is drawn off painlessly and never in such quantity as to weaken the animal yielding it. The mares are kept in model stables, are inspected by a staff of veterinarians every day, and receive the finest food obtainable. In return they produce a serum which is virtually priceless in safeguarding the lives of little children. One horse yields enough serum in a year to immunize a thousand babies from diphtheria! In the last ten years, this terrible disease has been reduced nearly fifty percent in frequency, as a result of diphtheria inoculation. The death rate has dropped from 16 in a thousand to 1.1!

HERE are six fat Poland China hogs, munching their provender as they go about the business of making the basic material of insulin, medical science's principle weapon in controlling diabetes.

"All we have to do is feed them," said Dr. Flexner, "and they'll probably produce enough insulin to aid 5,000 suffering from diabetes. Before we knew about insulin, diabetes was a real scourge, defying our most strenuous efforts to control it. But Dr. Frederick G. Banting, in making the discovery, found that the ordinary pig contained the element lacking in the pancreas of the human diabetic sufferer. After experimenting with dogs—who also suffer with diabetes—we tried insulin on human beings, and the results were marvelous."

I NOTICED a purring Maltese cat who was doing nothing in particular.

"What's her mission in life?" I asked.

"Oh that's Melissa," replied Dr. Flexner. "Melissa is a great help when we want to observe the action of anger, fear, and other emotions on the digestive tract. We feed Melissa fish, then peer into her stomach by means of the fluoroscope, and watch what happens when a dog growls at her, or a canary is placed just beyond her reach. She doesn't suspect that we're peering into her stomach, because the fluoroscope is painless in its operation. Of course, we use the information obtained from Melissa's stomach in diagnosing and treating human digestive ailments. We found that 'nervous indigestion,' so called, resulted from the failure of certain glands to function properly under exciting stimuli—the presence of a canary, for example. When we took the canary away, Melissa's glands began to pour out the necessary fluid, and the digestive process went forward once more. Applying this principle to human beings, we have been able to cure many a case of digestive trouble that previously resisted our medical treatment."

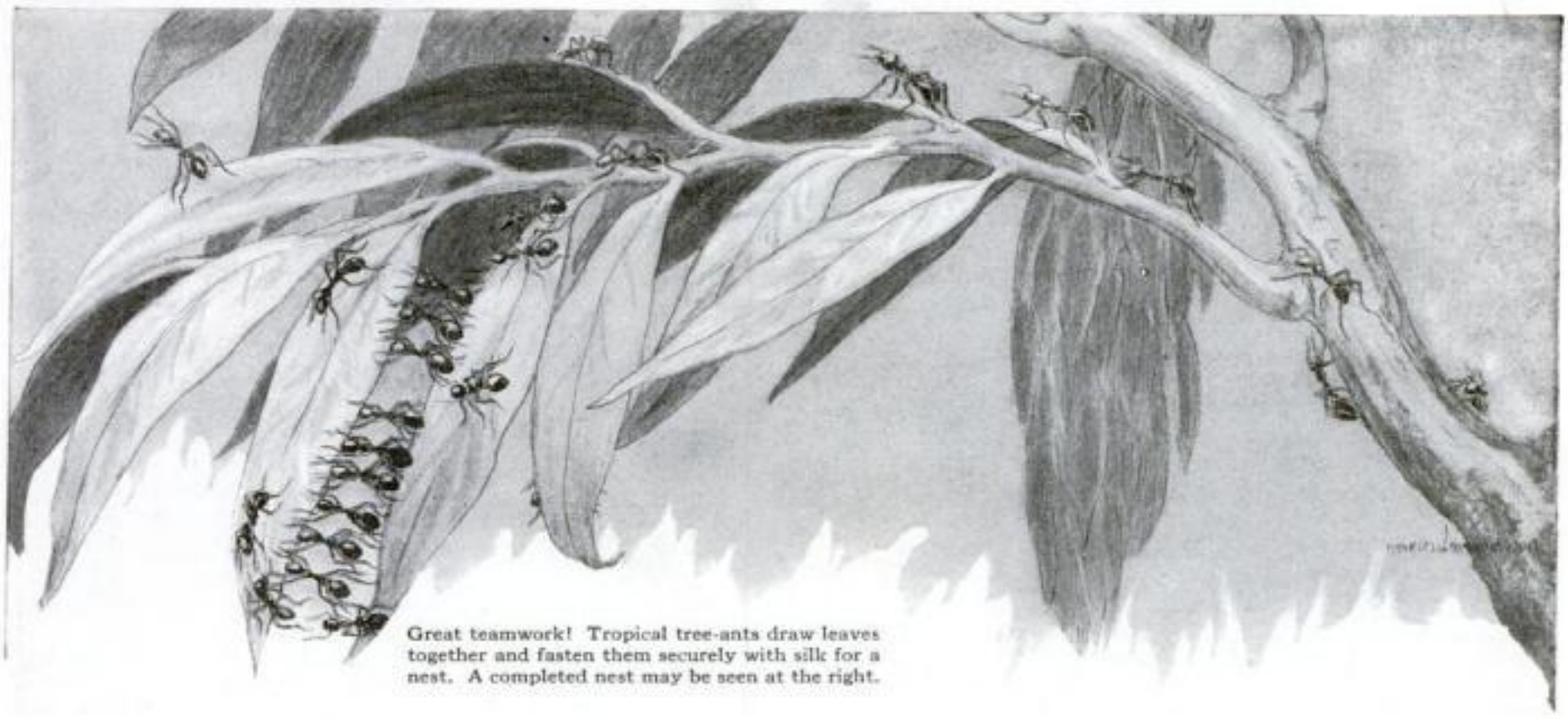
A kennel of barking terriers has aided the Institute doctors to perfect the "bronchoscope," an illuminating instrument used in examining the throat and lungs of suffering human beings. Many a safety pin and small toy has been dislodged from the windpipe of a strangling baby, simply because some unpedigreed pup has permitted the Rockefeller surgeons to insert the bronchoscope into his throat for experimental purposes.

Who would think that rabbits were valuable allies of science? Yet when the late Dr. Hideyo Noguchi was seeking a cure for yellow (Continued on page 143)

Cutting a cancer from the shoulder of a bulldog—a painless operation with a self-sterilizing "radio" knife, one of the newest surgical instruments.

Where animals offer their lives to test the safety of drugs. After a drug is manufactured, it is injected as shown into the body of a rat or guinea pig.

Do Insects Think Like Men?



Great teamwork! Tropical tree-ants draw leaves together and fasten them securely with silk for a nest. A completed nest may be seen at the right.

Almost Human in Ingenuity, Ants Build Amazing Tunnels, Houses, and Even "Stables" for "Cows"

By MICHEL MOK

WHILE waiting for a street car in a Nicaraguan city one afternoon not long ago, an English naturalist suddenly discovered that an absorbing drama was being enacted right at his feet. He saw a column of leaf-cutting ants scurrying across the tracks to reach some trees on the opposite side of the road. Wagons were continually running on the rails, and numbers of the insects were crushed to death under the wheels. At first, the surviving ants were thrown into confusion. But soon they found a way to stop the carnage. They dug a tunnel under each rail and proceeded serenely on their way!

The naturalist forgot all about his car. Amazed and delighted, he stopped the tunnels with stones to see what the ants would do next. The insects were undaunted. They constructed a fresh pair of tunnels!

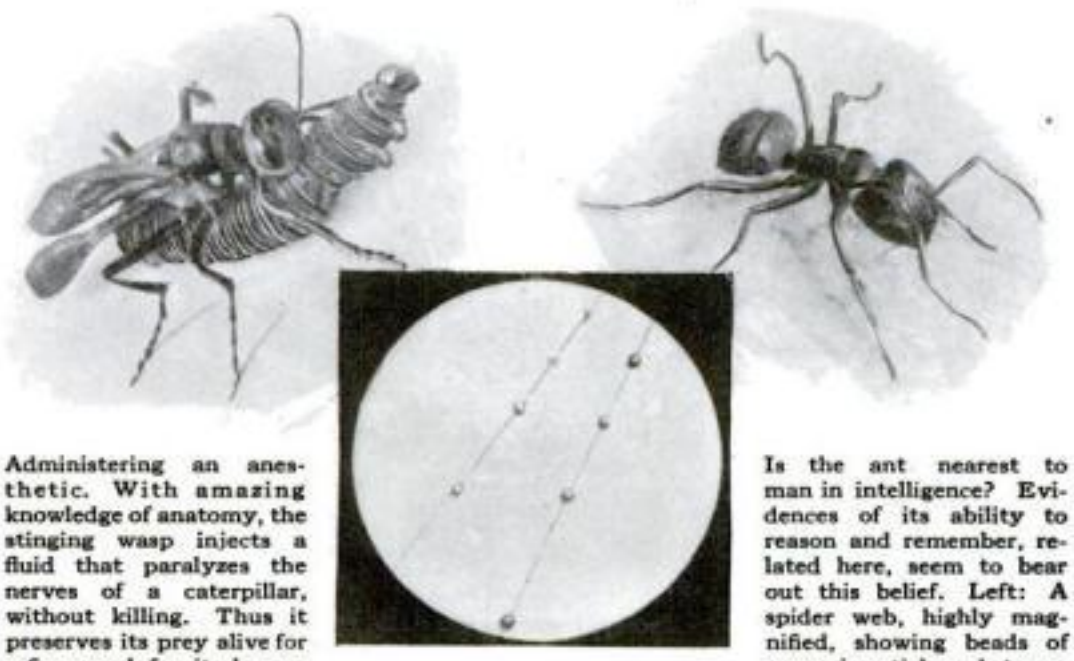
This incident is typical of a number of recent observations revealing the astonishingly humanlike reasoning powers of insects. It is closely matched by the experience of an entomologist on Porto Santo, one of the Madeira Islands, as described, like the Nicaraguan incident, by Major R. W. H. Hingston, distinguished British naturalist, in *Problems of Instinct and Intelligence*, published by the Macmillan Company, New York. This observer saw a swarm of ants coming through the window into his dining room. He tried to stop the invasion by spreading a sheet of fly paper across the window sill. But the ants refused to be balked. After a few of their number had been caught in the sticky stuff, their comrades ran off, but soon returned, carting sand and minute bits of wood. With these, they built tracks across the fly paper and so reached the sugar bowl!

Jean Henri Fabre, the famous French biologist, stoutly maintained that the behavior and actions of insects were directed by unconscious promptings of blind instinct. That contention now is challenged by Major Hingston after a study of insects in the jungle, high up in the Himalayan Mountains, and on the plains of India and Mesopotamia. His findings, some of them fairly startling in their revelation of insect ability to reason and remember, rather bear out the theory of Lord Avebury, the British entomologist who, some years ago, shocked the scientific world with the statement that insects are thinking creatures and that ants rank next to man in intelligence.

Among the most interesting of Major Hingston's observations was that of a species of ant inhabiting Central India which not only keeps "cattle" but in tending them shows as much care, cunning, and resourcefulness as any human herdsman! It has long been known that many ants keep "cows," other insects called aphids which excrete a sweet fluid; that the ants "milk" these "cows" by stroking their backs, and even build "stables" in which to house them! But it was left for Major Hingston to discover that, in emergencies, the ants know exactly how to protect their herds and how to catch them if they try to escape from their corrals!

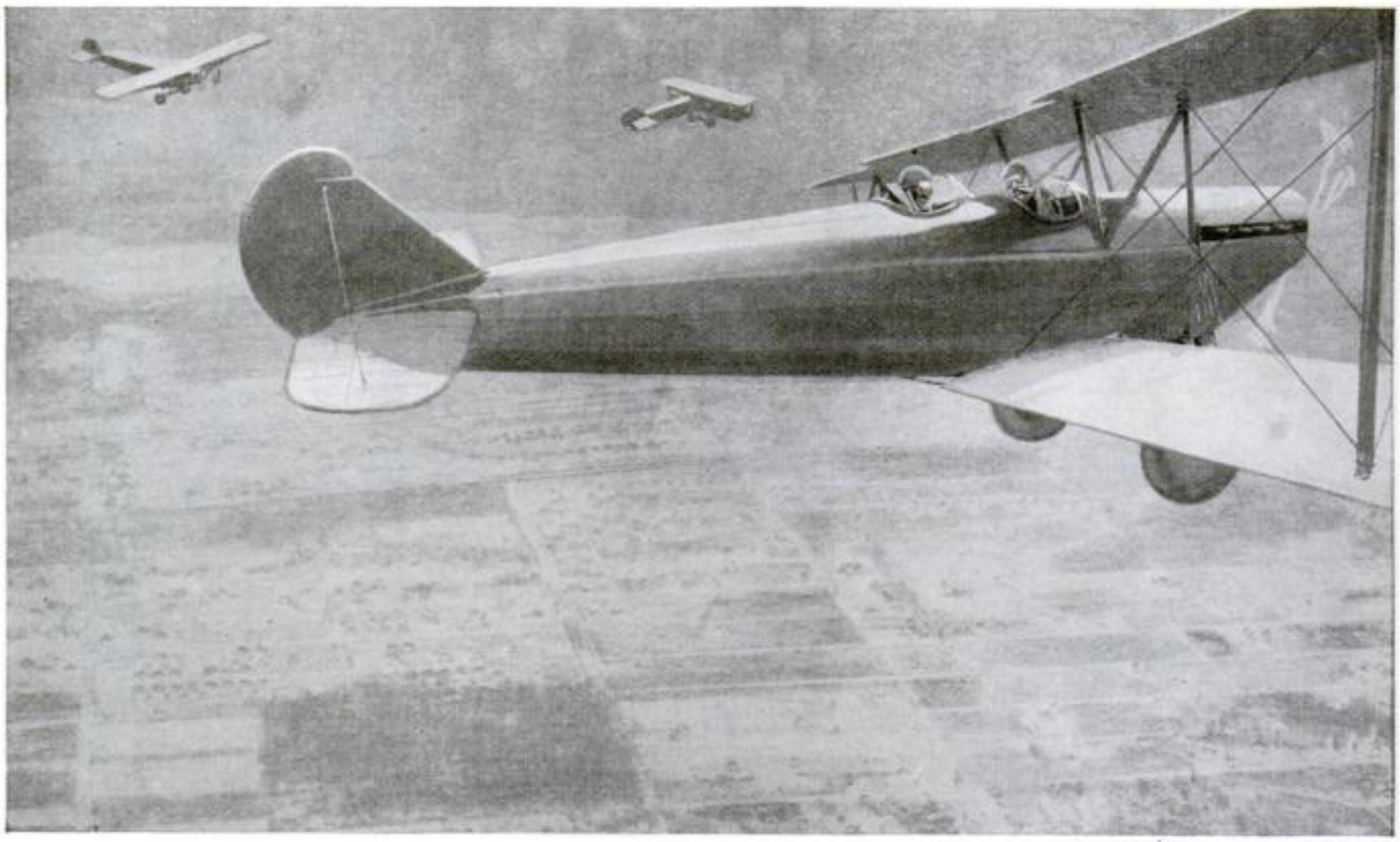
The insect "stables"

(*Continued on page 150*)



Administering an anesthetic. With amazing knowledge of anatomy, the stinging wasp injects a fluid that paralyzes the nerves of a caterpillar, without killing. Thus it preserves its prey alive for a fine meal for its larvae.

Is the ant nearest to man in intelligence? Evidences of its ability to reason and remember, related here, seem to bear out this belief. Left: A spider web, highly magnified, showing beads of ensnaring sticky substance.



Today I got my first real "kick" out of flying. The ground was no longer a bewildering confusion. I began recognizing landmarks—villages, estates, roads.

I Am Learning to Be a Flyer

"Rawhide" Lessons from Lindbergh's Old Pal—Another Breath-Taking Day in the Life of a Young Rookie Pilot

By LARRY BRENT

"RANDY Enslow is back," said the school manager. "You're on his list for nine o'clock."

He wrote out the brief record of my flying experience on a little white card which I must give to Bill Bates, the contact man, before going up for a lesson. I started for the line, where the motors of the blue biplanes where being warmed up.

I had begun to think that Randy Enslow was not a flying instructor but a rumor—or a mythical hero. Since I had enrolled, he had been ill with flu. I had heard so much about Enslow that I was impatient to see him. Among other things—

His age was twenty-eight. He had flown approximately 3,000 hours. He was an old pal of Lindbergh's. They were "barnstormers" before Lindbergh went into the air mail. Enslow had done every kind of flying; had flown passengers, freight, express, and air mail. He had flown in the Army. He had done hundreds of hours of night flying. He had trained 500 students. He was a veteran cross-country pilot and one of the most daring stunt flyers in the United States. He had had countless hair-raising adventures; had been piloting planes when they burst into flames; had made parachute jumps. Bud Owens, one of the advanced students, had told me on the day I enrolled:

"You'll like Enslow fine. He pours rawhide and that's what you want."

Bill Winston, the Curtiss Field manager, famous as the man who taught Lindbergh, had said to me:

"Every instructor has a different method. You'll learn to fly as your instructor flies."

Another student had said: "It's a big help if you like your instructor and admire the way he flies. A little hero worship is necessary."

I reasoned that it ought to be easy to admire a man who flew as well as Randy Enslow. Since I had been in the air, my admiration for the "aces

Photographs of the author by D. Warren Boyer

At the "dog house" Bill Bates introduced us: "Mr. Brent—Mr. Enslow." Enslow smiled. He gave my hand a quick grip and said: "Let's see your card."

of commerce" had multiplied. Yes; hero worship was easy. And I wanted rawhide. But I was not prepared for Randy Enslow.

He was standing near the "dog house" on the line, talking with Bill Bates the contact man. (The contact man, as the name implies, is a sort of liaison officer between students and their instructors.) I had never seen Enslow, but there was no question in my mind that this was Enslow. He looked the part: A tall, lean man, with sharp, quick, bluish-gray eyes, a snub nose, a good chin. He was wearing a snug-fitting winter flying suit of blanket-lined khaki, a helmet buttoned tight under his chin, flying boots of leather.

BILL BATES introduced us: "Mr. Brent—Mr. Enslow. Brent is on your list for nine, Randy."

Enslow looked at me. He smiled. He gave my hand a quick grip and said: "Let's see your card." I gave it to him. I felt nervous. Enslow frowned.

"You've been up before."

"With Jordanoff, while you were sick."

Without another word, he turned and strode off toward one of the planes. It was blue with a red tail. I followed. I sensed that something was wrong. Something was. Instructors don't like taking other instructors' students. When we

When we reached the plane with the red tail, Enslow said, briefly: "Climb in." I did so.

reached the plane with the red tail, he said, briefly:

"Climb in." I climbed in.

My helmet was equipped with a speaking tube which ran from a mouthpiece in the forward cockpit to rubber disks in the helmet.

The motor was idling. Enslow was in the forward cockpit before I had the safety strap buckled at my waist. The motor roared. I wondered if Enslow was going to give me the usual preliminary talk. Evidently not. Through the speaking tube he asked: "Done any taxiing?" I shook my head. "All right. Do some now. Take her down there by the golf course. Hold your stick back hard."

I had never had my hand on the throttle before. I advanced it cautiously.

"Give her some gas!"

I did so. We jolted along toward the golf course. Taxiing was different from flying. At flying speed, the slightest touch on the rudder pedals would turn the plane sharply. On the ground I had to kick the rudder hard.

"Keep her going straight."

I tried. It was hard work.

"You're trying to steer with your throttle. Steer with your feet!" Advice, orders, criticism came pouring through the tube:

"Take it easy going down this hill. Don't ground-loop her! Give her less gas. Are you trying to fly her? Watch out for this fellow coming down—he has the right of way. Now give her some gas. Kick that right rudder. All right. Let go."

I let go. We had reached the end of the field. Often a preliminary talk is given here—just before the take-off.

Enslow swung the ship around into the wind in a smart turn. The motor roared. The propeller sent an icy gale into my face. There was going to be no preliminary talk. We were flying along the ground. I was beginning to realize what students meant when they said that every instructor has a different method. My temporary instructor, Jordanoff, had been gentle and persuasive.

We climbed fast. Over the hangars, Enslow put the ship into a sharp bank. It was so sharp that it took my breath. And I was not prepared when he barked: "Grab her."

Enslow's favorite expression was: "Run your ship; don't let your ship run you." So at every opportunity I studied the workings of the various machines about the field.

HIS hands appeared on the cowling. I grabbed her. My feet slid to the pedals. My hand clutched the stick, but I remembered in time to hold it lightly, as lightly as if it were made of spun glass and would crush if squeezed.

"Climb her!"

I pulled the stick back and kept my mind on stalling. Enslow's hands remained on his cockpit cowling. He was looking over the side of the ship across the field. I could see his profile, and below his goggles was a grin. I wondered what he was grinning about. It occurred to me that he was looking forward to pouring rawhide. Well, rawhide was what I wanted.

"That's enough. Fly her level. Fly

for that black cloud," ordered Enslow.

I steered for the cloud. I looked at my altimeter: 800 feet.

"Keep your wings level. Right wing's up."

I made corrections. He waved his right hand. I thought he was waving to somebody in a passing plane. But no plane was in sight. He roared into the tube: "*Right turn!*"

I started a right turn, an easy one; just a little rudder, just a little stick. Enslow roared: "Make it snappier." He grabbed the stick, pushed it over, and pulled it back. At the same time, I felt him give the right rudder a kick. His hands reappeared on the cowling of the forward cockpit.

THE stick was back in my lap. The wings were almost vertical with the ground. We were in a tight turn. The horizon was shooting past the nose so fast that it was a blur. I became dizzy. Around and around we went. I started to straighten the ship, but Enslow ordered:

"Keep her there. Use your rudder. Don't be afraid to use your rudder. You're rudder shy. Kick it!"

That rudder was becoming the bane of my existence. Sometimes, the slightest touch was too much. At other times, the hardest kick wasn't enough.

I put the ship back into the turn and tried to remember all of the things a flyer must bear in mind on a turn. Too much rudder or too much stick—side slip. Nose too low—dive. Nose too high—stall, possibly followed by a tail spin. The sharper the turn, the greater the possibility.

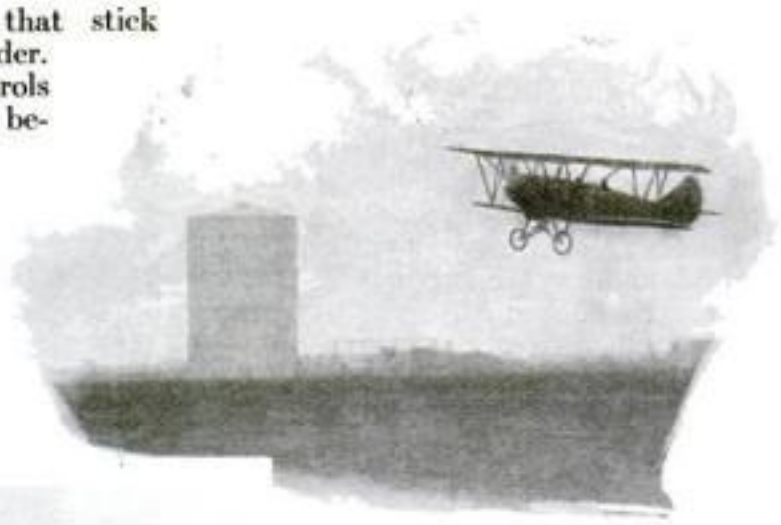
Around we spun, faster and faster. A chuckle came through the speaking tube. Then: "Get that nose down!"

The nose went higher as he was talking. The motor was slowing down, laboring. I tried to bring the nose down by pushing the stick forward. The nose did not respond.

Enslow barked: "Keep that stick back. Kick your bottom rudder. In a sharp turn, your controls are reversed. Your elevator becomes your rudder and your rudder acts as an elevator. Kick that bottom rudder!"

I kicked it. Down came the nose. At once I felt a sharp draft on my right cheek. That meant a side slip inwards. I tried top rudder, bottom rudder. I waggled the stick. The draft continued. The horizon was going past in an awful blur. I learned later that, in a turn as sharp as that one, the horizon was shooting past the nose at 1,200 miles a minute!

"Tonight," said Enslow, "sit down and say to yourself: 'In sharp turns, kick that bottom rudder to bring the nose down!'"



Students use this water tower as a landmark to guide them into Curtiss Field.

So this was rawhide!

"Hold her there!" said Enslow. "Now, without straightening, put her into a snappy left turn."

I somehow did. When I had held her in a left turn for six or seven revolutions, Enslow said:

"Straighten out slowly. Stick forward! Bottom rudder! Learn to roll out of your turns. If you come out too suddenly, you'll slip. Level her off! Stop that skid! Run your ship; don't let your ship run you! Fly for that water tower."

The horizon swam. But presently it steadied. I picked out the water tower and steered for it.

I discovered that I no longer wanted to clutch the stick, and that I was more relaxed than I had ever been. I also found that I could look out between the wings and down at the ground and on either side and up aloft without feeling that the ship would slide off into a spin because I wasn't gluing my eyes on where the horizon cut the nose. I was getting the feel of it.

AND for the first time I really enjoyed flying. For the first time since I had enrolled I saw myself, another Lindbergh or another Enslow, piloting the mail through fogs and night, flying passengers safely from airport to airport. A long, hard road stretched ahead of me, but it was pleasant to see the goal again.

Enslow made me do more turns. My trouble, in the sharp ones, was not enough bottom rudder. In watching my angle of bank and speed of turn, I would forget that the nose should be a little lower on the horizon than in straight flying.

He said once: "Remember, down is always safe, even if the ground is down there; up is always dangerous. In case of doubt, put your nose down."

Something shot past overhead—one of the Army planes from Mitchel field. I had the ship in a right turn. Enslow barked:

"Bottom rudder!"

I gave the bottom rudder a vigorous push. Even with that push, the nose was yanked up by the slipstream (wake) of the Army plane.

Enslow explained: "If your nose had been much higher, the wake of that ship would have pulled it up and set you into a spin."

I THOUGHT to myself: there is so much to learn, and so much to watch. Every moment you're flying you must have a landing place in sight; you must be aware of everything that is in the air. I recalled what Bill Winston had said at one of the afternoon lectures:

"Your ultimate aim must be to fly a ship as unconsciously as you walk, so that you will be free to do the important things."

Enslow's favorite expression was: "Run your ship; don't let your ship run you."

I used to ride (*Continued on page 134*)

One of the first ground lessons that I had to learn was the trick of spinning the propeller by hand to start the motor.

Under Arctic Ice to the Pole!

How a submarine will be equipped to creep under Arctic ice. Drawn especially for POPULAR SCIENCE MONTHLY by B. G. Seielstad.

CAPT. SIR HUBERT WILKINS, just back from exploring the Antarctic, now plans to start for the North Pole in a submarine. Naval and scientific experts have endorsed as feasible his astounding plan for an undersea cruise beneath polar ice, which he has scheduled for next year.

A crew of seven men will run the craft, while Sir Hubert and four scientific observers take soundings with modern depth-finding apparatus to determine whether the Arctic Ocean is a cone-shaped depression or a wide basin—the principal objective of the trip.

Wilkins proposes to start his strange cruise from Spitzbergen, and cross the Arctic Sea to Alaska. It should take about a month, he says. He counts on making more than sixty miles a day, remaining under water for fourteen hours out of each twenty-four. The rest of the time he will be at the surface recharging his batteries. Only electric power can be used under water, as the ship's Diesel motors would use up precious air.

The *Defender*, only privately owned submarine in the world, will be used for the great adventure. Simon Lake, submarine inventor, built it in 1906. Despite its age, it is said to be as staunch and safe as any recently constructed submarine.

A superstructure of steel beams will enable the *Defender* to crash through the ice to come up for air, should it fail to find stretches of open water. It will carry charges of thermit, an ice-melting explosive, for emergency. A cogwheel device atop the hull will revolve in contact with the ice and measure the distance traveled. Wheels on top and bottom enable the *Defender* to glide just beneath the ice, or on the sea floor.

Thirty years ago Simon Lake first proposed that underwater craft could explore ice-covered seas. Four years later, in the submarine *Protector*, he cruised beneath eight-inch ice in Narragansett Bay, R. I. Today he foresees the northernmost parts of Canada and Siberia colonized by passenger submarines running under the ice fields.

Longest Airway Links Americas

A huge German tri-motored Junkers plane at anchor off Rio de Janeiro. It transports passengers, mail, and freight between Brazilian coastal cities.

Flying over Jungles, into the Heart of a Vast Continent, Airplanes Are Unlocking Golden Lands of Treasure

By

ALDEN P. ARMAGNAC

FOR the first time in history, mail planes are to fly between North and South America. Recently the Post Office Department announced that it had awarded an air mail contract to a U. S. firm for operating an airway from Cristobal, in Panama, down the west coast of South America to Santiago, Chile. For sheer magnitude the project is unequaled in air history. With its connections to Canada, through the United States, it is by far the longest airway in the world. The portion running south from Florida, via a recently opened Miami-to-Panama route, is alone 4,300 miles long.

Nor is this new air highway that inaugurates more than mile-a-minute travel from New York, Chicago, and other U. S. cities to South America the only avenue in prospect. Already another line from Panama to Dutch Guiana is under mail contract.

Airmen are looking south, these days. They see a great continent of fabulous riches, ready for the tapping. Air lines in South America, springing up under the spur of European and American influence, are linking the whole enormous group of countries in a new network of communication. The Midas touch of the airplane is transforming everything it meets to gold, by giving a swift new outlet for the products of hitherto inaccessible provinces.

Nowhere in the world, perhaps, do the old and the new modes of travel contrast so vividly, side by side, as in South America. You may still, if you wish, travel on the back of a mule the three-hundred-mile trail from Cochabamba to Santa Cruz, in Bolivia. The trip takes just three weeks. Every week a plane of the new air line makes the same trip in three hours. Again, a small, crowded stern-wheel steamer winds its way up the Magdalena River, in Colombia, to take travelers from Barranquilla, at the mouth, to Bogota in the interior. The trip takes from nine days to one month; no one can tell you exactly how long. "It all depends"—among other things, on whether the boats run aground in the treacherous river, which not infrequently happens. Today seaplanes leaving Barranquilla daily whisk a voyager up the river as far as the town of Girardot, whence it is a few hours overland to Bogota: total time, nineteen hours!

Perhaps the most timesaving air service of its kind in the world is that which Peru has inaugurated between San Ramon, near the Pacific Coast city of Lima, and the inland, jungle-bound city of Iquitos, at the headwaters of the Amazon. Here rich timber, mineral, and rubber resources have remained inaccessible. Until recently, Peru sent Iquitos-bound mail from Lima to New York; thence to Rio de Janeiro, Brazil, on the Atlantic seaboard, and finally clear across South America, via the Amazon, to Iquitos. By that route it took a letter six weeks to cover the 800 miles between Lima and Iquitos!

FORMERLY travelers from the seacoast, if they cared to risk the uncomfortable and dangerous trip through the jungle to Iquitos, crossed the first range of the Andes by rail and motor car to San Ramon, and then embarked perilously at sources of streams through the wilderness. Today, Keystone mail planes carry the passenger in speed and comfort to Masisea, the nearest point on a water route to Iquitos. There he changes to a seaplane that takes him the rest of the way. The whole trip requires only thirty-six hours.

These typical examples give some idea of the tremendous revolution that aviation is working in South America. Where the mountainous peaks of the Andes and the swampy banks of treacherous rivers have hindered the building of railroads, the air lines rule supreme. To them the countries of South America look for a new network of communication that will make them mighty powers in world commerce.

European interests have been quick to grasp the importance of air development and the vital part it will play here. While the United States was still considering the extension of its air lines southward, German and French capital paved the way for local and Europe-bound lines.

One of the most ambitious

A sky view of the forbidding country over which planes fly between Tampico, Mexico, and Mexico City. Usually they travel at a height of two miles.

A speedy seaplane of the German "Scadta" lines in Colombia, taking off for a trip over the jungles.

Airplane view of Buenaventura, Colombia; airport is in foreground. Every important Colombian city is within reach of air service.

This map shows present and projected air lines linking Americas.

Four monoplanes of the Lloyd Aero Boliviano system on the flying field at Santa Cruz, Bolivia. They afford access to otherwise inaccessible regions.

Flying boats on Lake Guaynacota, Bolivia, 10,000 feet above sea
Above: Mule travel along the 300-mile route from Cochabamba to Santa Cruz, Bolivia. Planes cut time from weeks to hours.

of all is the French organization, the Compagnie Generale Aeropostale, which operates planes all along the eastern coast of South America from Buenos Aires, Argentina, to Natal, Brazil. Thence fast mail steamships ply across the Atlantic to St. Louis de Senegal, on the northwest coast of Africa, connecting there with mail planes from France.

Meanwhile the Condor Syndicate, a German firm, has inaugurated a successful service along the Brazil coast. Its Dornier and Junkers flying boats carry passengers, mail, and freight between Rio de Janeiro and Porto Alegre, northern and southern limits of the route, respectively, in one day, as against five by steamer.

In Colombia, the German firm that bears the imposing name of the Sociedad Colombo Alemana De Transportes Aereos, and is known as "Scadta" for short, has pioneered in the development of an

(Continued on page 158)

New Calendar by 1933—*Eastman*

America's Genius of Photography Tells Why a Year of Thirteen Months Will Make Us All Richer and Happier

By FRANK PARKER STOCKBRIDGE

FROM time to time, ever since the close of the war, we have heard talk of changing our present calendar. Many have had the hazy idea that it is some wild-eyed scheme likely to scramble all our calculations and turn affairs topsy-turvy. In this extraordinary interview, the prime leader in the movement for calendar reform—an American inventive genius whose name is familiar to everyone who has taken pictures with a pocket camera—explains why he believes the proposed year of thirteen months will put more money in our pockets and give all of us more time for worth while leisure. "I am interested," he says, "in showing people how to get the most out of life."

THIRTEEN Fridays in every year falling on the thirteenth of the month will be one of the curious things which will happen if and when the movement for calendar reform, under the leadership of George Eastman, of Rochester, N. Y., achieves the result which Mr. Eastman and his associates are seeking.

Many people thought that all the talk about calendar reform, which has been going on for ten years in Europe and for more than half that time in America, originated with wild-eyed visionaries or jokesmiths. Quite the reverse is true. But it took Mr. Eastman's serious advocacy of the thirteen-month year to convince the unthinking that it might be possible to do what has been done a dozen times in the past, to establish for the civilized world a new and improved method of measuring the passage of time.

Today, in all seriousness, the world faces the possibility that, perhaps as early as 1933, we shall begin to calculate time in units of twenty-eight days, thirteen of them to the year, with an extra day each year as a sort of general holiday, and a second extra holiday in Leap Year for good measure.

SCIENTISTS generally favor the change. Dr. Charles F. Marvin, chief of the United States Weather Bureau, has been one of its ardent advocates for years. The Chamber of Commerce of the United States is expected, at this writing, to support the reform. The plan has been endorsed by the National Association of Cost Accountants, the National Academy of Sciences, the Pan-American Conference held in Havana last year and by hundreds of business men. During the next session of Congress action is expected in the form of a resolution authorizing the President to call an international conference, or to accept an invitation to an international conference to consider calendar reform. Such a joint resolution was introduced by Representative Stephen G. Porter of New York in the last Congress and will be reintroduced, with every prospect of adoption.

Across the Atlantic, the calendar reform movement has been gaining momentum for nearly ten years, since the League of Nations appointed a committee to study the question. Many governments and business and religious bodies are on record in favor of some new plan for measuring time. As the United States is not a member of the League of Nations, the movement languished on this side of the ocean until Mr. Eastman, about four years ago, put the force of his personality and the support of his dollars behind it. Since then it has been gathering momentum in America like a snowball rolling downhill.

The National Committee on Calendar Simplification, of which Mr. Eastman is chairman, contains such names as those of Dr. Marvin of the Weather Bureau; Dr. G. K. Burgess, Director of the U. S. Bureau of Standards; A. H. Harris, Chairman of the New York Central Railroad; Adolph S. Ochs, Publisher of the *New York Times;* Silas H. Strawn, former President of the American Bar Association; William Green, President of the American Federation of Labor; Gerard Swope, President of the General Electric Company; Prof. W. S. Eichelberger, Director of the Nautical Almanac; Dr. John J. Tigert, former U. S. Commissioner of Education, and numerous other leaders in many fields of industry, commerce, and science.

IN SHORT, George Eastman has started something.

I went to Rochester to see Mr. Eastman, accompanied by the artist who drew his portrait especially for this article. I wanted to find out, if possible, how he came to be interested in something so far removed, apparently, from his other activities and interest. How did calendar reform fit in with what the world knows of George Eastman, multimillionaire manufacturer, philanthropist, big-game hunter, patron of music and education?

THE massive door of his magnificent Georgian mansion admitted us to a great hall paved with tessellated marble, strewn with costly Oriental rugs, banked with flowers, hung about with paintings which evoked the instant admiration of my artist companion. The sound of organ music came through the arches leading into a larger room beyond. The butler ushered us into a leather-upholstered library where the array of paintings and statuary so engrossed us that we hardly noticed that the organ had ceased playing until a quiet voice said, "Good morning." We turned to see our host entering from the music room.

George Eastman bears his seventy-five bachelor years lightly. He tossed the end of his cigarette into the fireplace and stood erect on the hearth, his faint smile illuminated by the enthusiasm in his blue eyes as we spoke first of music and his efforts to make his home city one of the great musical centers of the world.

"We are trying to instill an appreciation of music which will help those who gain it to get more happiness out of their leisure hours," he said.

The enjoyment of leisure is the subject on which Mr. Eastman waxes most enthusiastic. Logical enough, when one considers that his life's work has been to provide means for the enjoyment of leisure, through the invention of the photographic dry plate, then the film camera and its latest development, the moving picture cameras for amateurs.

FROM those and supplying the raw material with which Hollywood works have come the fortune which makes George Eastman one of the dozen or so wealthiest men in the world.

He is through with business now. He enjoys his own leisure with his music and his flowers, with hunting trips, and with the effort to change the world's system of keeping track of time. On the wall of the great two-storied room where the organ stands is the head of a giant tusker, one of the trophies of his recent hunting trip to Africa.

"That's the (Continued on page 130)

Drawn from life especially for POPULAR SCIENCE MONTHLY *by B. J. Rosenmeyer*

George Eastman, Apostle of Leisure

Inventor of photographic dry plates and film cameras, Mr. Eastman is the man who made amateur photography possible. Now, at the age of seventy-five, he is devoting much of his time to the movement for reform of our calendar. By dividing the year into thirteen equal months, he believes, industrial efficiency will be increased, and men will have more time for worth while recreation.

Mr. Eastman recently demonstrated the proposed thirteen-month calendar before a committee of Congress.

35'140

The 1929 POWER BOAT FLEET

Speed, and then some! These sporty "Sea Lyons" are having it out, nip and tuck. At left is a thirty-footer with maximum speed of forty-five miles an hour. At right, a twelve-passenger two-step hydroplane capable of sixty miles an hour, one of the largest, fastest standard runabouts ever built.

UNDREAMED-OF speed in small boats; greater comfort and luxury; freedom from traffic congestion of highways—these have made power boating one of the most popular of all sports. Here are pictured some new designs, including outboard craft, to be seen this summer.

Dee Wite six-passenger, a fast power boat for the whole family. Its outboard motor, of advanced design, is cleverly concealed.

Two Pullman berths and two berths in the stern seat provide sleeping accommodations for four in the thirty-five-foot Whitney cruiser, at left. It has a galley and a gas heater. Its speed is fifteen to twenty-two miles an hour.

Home on the waves. All the conveniences of a fine residence are contained in the luxurious Consolidated houseboat cruiser pictured at the right. It measures a hundred feet from bow to stern.

This beautiful 500-horsepower runabout of Luders Marine design can rip along at sixty miles an hour. It is ideal for cruising or commuting where unduly heavy weather is not likely to be met.

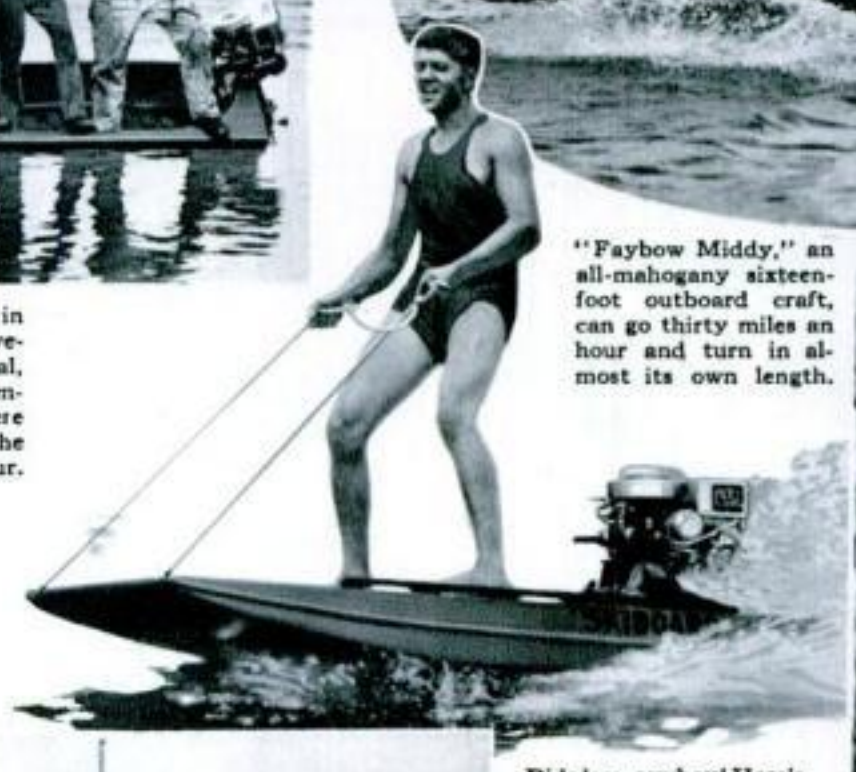
A gay party of eight out for an afternoon spin in a Dodge "Watercar," a twenty-six-foot open runabout capable of speeds up to forty-five miles an hour. It has a 200-horsepower motor.

This cozy A.C.F. cruiser runabout glides along at twenty and a half miles an hour, powered by a 100-horsepower motor. It has a roomy windowed cabin with sleeping accommodations, and a sheltered "front porch."

The thirty-two-foot Robinson "Seagull," one of the fastest of sedan cruisers. It makes thirty-two miles an hour. The cabin contains comfortable berths, upholstered seats, built-in lockers, and a smart little galley.

They can't sink it! A five-foot air tank in the bow of the "Baby Steelcraft," a twelve-foot outboard boat of eighteen-gage metal, is said to hold up the weight of passengers and engine in case of accident. There is not a bolt, rivet, or other fastening in the all-metal hull. It goes thirty miles an hour.

"Faybow Middy," an all-mahogany sixteen-foot outboard craft, can go thirty miles an hour and turn in almost its own length.



Ride 'em, cowboy! Here's the latest water novelty—the "Skiboard," a speedy aquaplane driven by an outboard motor. It would hardly be the boat for commuting, but it's thrilling sport—if you don't mind taking the chance of a ducking.

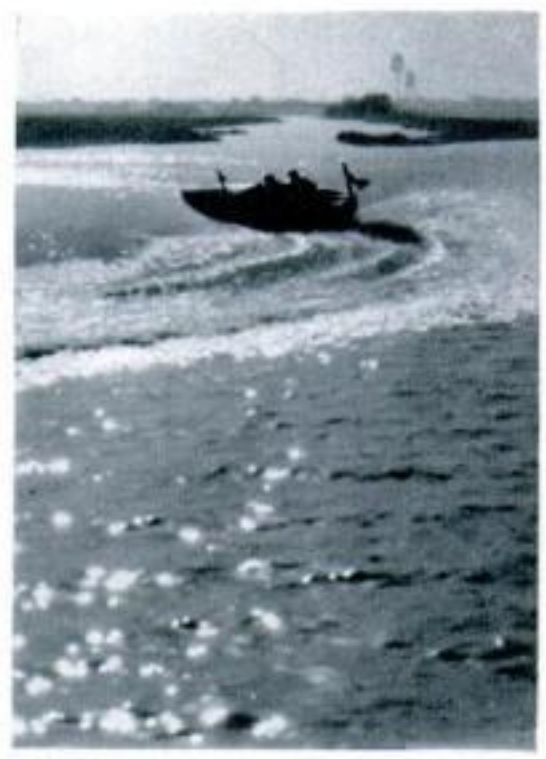
Only six feet long, the Wood Brothers "Chip" is said to be the smallest outboard motor boat made. Its sixty-pound hull has unique triple planing surfaces on the bottom, designed for skimming over smooth or rough water.

A rugged fifty-two-foot Diesel cruiser, the *Fayanne II*. This Humphreys boat is designed especially for long cruises, and is built to weather heavy seas. Its roomy cabins are elaborately equipped to provide vacationists with all the comforts of home.

How these little fellows can go! At the right is a "Three Star Ensign" outboard craft of Pigeon Hollow make, doing twenty-eight miles an hour with two passengers. Only sixteen feet long, it is safe and serviceable.

The Fairchild "Voyageur," a twenty-three-foot outboard with sleeping berths for two in its cabin. It makes twenty miles an hour.

Elco "Fifty," a luxurious fifty-foot, twin-screw yacht for six passengers and a crew of two.



Turning at forty-two miles an hour. This "Fast Runabout," a Non-Capsizable outboard, is banked by troughed bottom.

Seventeen miles an hour is fast enough to enjoy life on the A. C. F. forty-seven-foot cruiser at the left.

Speed and reliability combine to make this Chris-Craft runabout an ideal little boat for sport on inland waters.

The Boyd-Martin "Bullet," a twelve-foot outboard speedster, can scoot at thirty to fifty miles an hour.

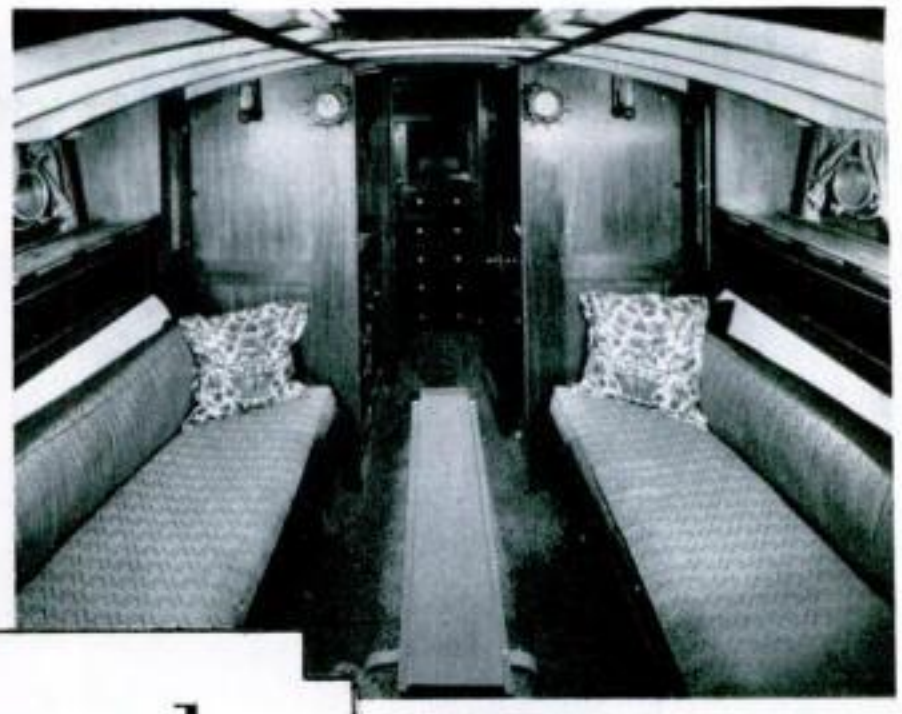
A lightweight sixteen-foot outboard boat for sports and fishing is this Old Town "Square Stern" model.

The "Sea Sled," a remarkable twenty-six-foot speed craft with curved-in bottom. This model slides over the water at forty-two miles an hour, and it is said to weather six-foot waves without danger or discomfort.

Chenevert "Corsair Crusader," a thirty-foot day cruiser with large forward cockpit. Above is a Richardson "Master Cruisabout," a twenty-eight-footer with berths for four.

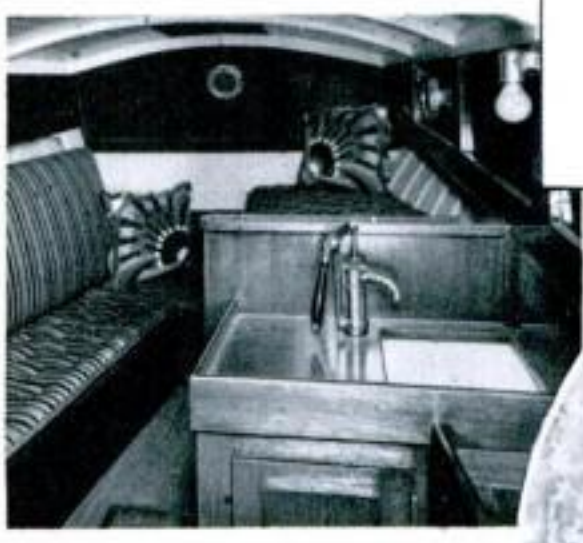
One of the fastest small cruisers afloat—the Banfield "32," a deep-sea, all-weather craft. Above is the luxurious Huckins "Fairform Flyer." It maneuvers like a fine car.

Interior of a Staples-Johnson cruiser—typical of the luxury and convenience of the new power boats. The pilot sits at the wheel, driving the craft as he would an auto. Note clear-view windows and easy chairs for passengers.



There's plenty of chance for a good night's sleep after a day's cruise in this cozy cabin of a Hubert-Johnson cruiser. The upholstered seats on both sides can be converted into berths comfortable enough for the most exacting passenger.

Improved Motor Boat Fittings



An exceedingly useful corner in the cabin of the Wheeler cruiser contains a sink with a constant supply of "running water" from a sea-water pump. Beneath the sink are handy cupboards for dishes, cooking utensils, and other paraphernalia. Note the electric light.

A powerful four-cylinder outboard motor—the Johnson "Sea Horse." A novel feature is a "release charger" that releases compression from one cylinder and makes it easy for a woman or child to start the motor. It is silenced by underwater exhaust.

All the conveniences of the kitchen at home are contained in this remarkably complete galley of a Humphreys cruiser, equipped for long voyages. It includes a sink with running water, hot water tank, large cooking range—in fact, all that any housewife could wish for.

An Evinrude outboard motor, one of a line of speedy two-cylinder models for small craft. Just attach it to the rowboat, skiff, or what you will, give the flywheel a whirl, and away you go. Inshore the propeller swings upward.

Safety against fire in motor boats is offered by the Lux system of fire control, the heart of which, pictured here, is a tank containing extinguishing compound. This is piped to strategic parts of the boat.

The Paulson electric bilge pump, an up-to-date labor saver. It can be installed on most any power boat equipped with an electric lighting or starting system. Simply throw a switch and it starts.

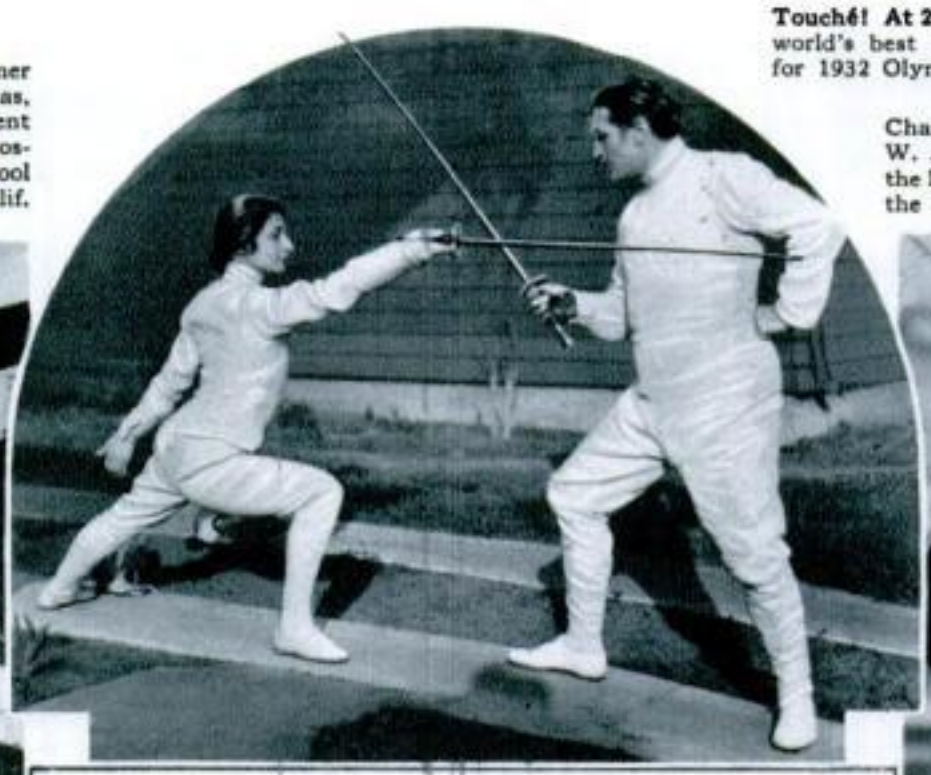
A novelty in motor boat fittings—the Herbst propeller unit, which permits placing the engine in the stern out of passengers' way. A drive shaft at the top, coupled to the engine, is connected through gears with the propeller below.

Ever Hear of These Champs?

Meet the "Babe Ruths" of Some Sports That Seldom Get into the Newspaper Headlines

Robin Hood himself never pulled a meaner bow than does Clinton W. Douglas, world's archery champ. In a recent tourney he scored 704 points out of a possible 810. Incidentally he's a high school science instructor in Los Angeles, Calif.

Touché! At 21, Mlle. Jeanne Vical, of Los Angeles, is world's best woman fencer. Here she is training for 1932 Olympics with her father, who taught her.



Champ pipe smoker? No indeed. This is W. A. Burt, of Decatur, Ala. acclaimed the lustiest horn blower in all America by the National Fox Hunters Association.

Ten to one it's a ringer! Blair Nunamaker, of Cleveland, O., winning the world's horseshoe pitching title in a recent "barnyard" golf tournament at St. Petersburg, Fla.

Miss Maribel Y. Vinson and Roger F. Turner, both of Boston, Mass., hold respectively the U. S. women's and men's figure-skating titles.

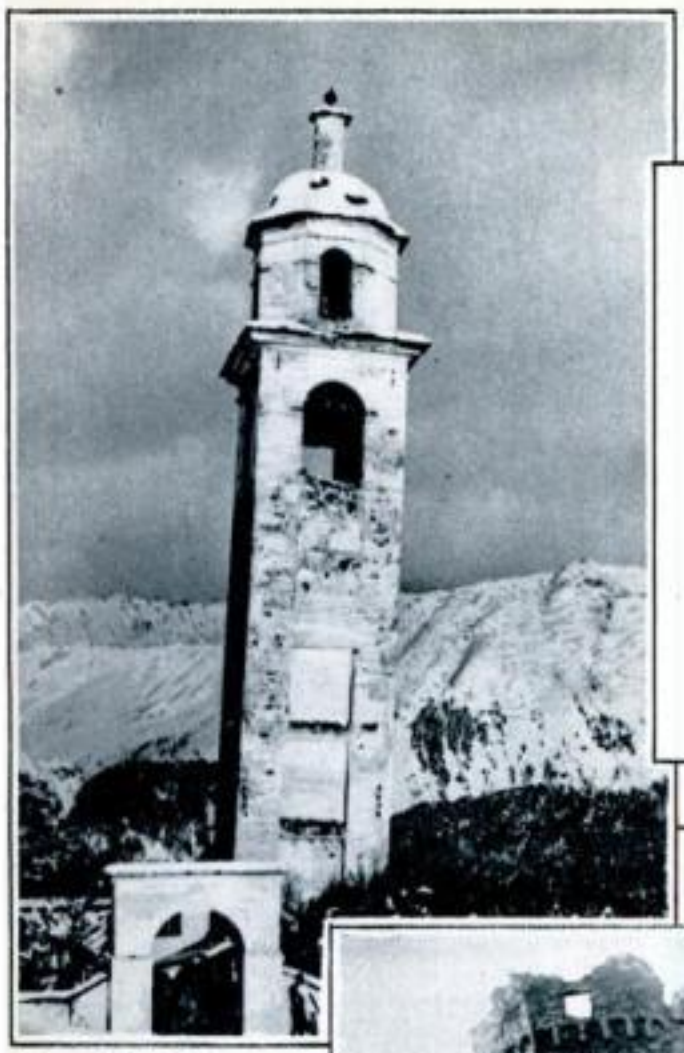
Dubs and fen everything! Here's the king of America's marble shooters—Alfred Huey (left) of Akron, O., talking it over with Dominic Cartelli, New Britain, Conn., whom he defeated in a final match for the championship.

Doesn't pay to fool with Tom Tyler, Los Angeles strong man. He holds the American amateur weight-lifting title for the feat of heaving 760 pounds.

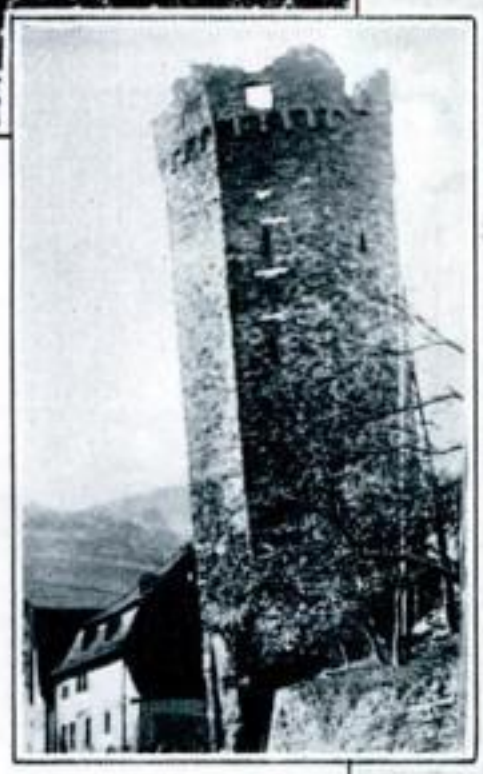
Sergt. C. J. Cagle, U. S. Marine Corps, national individual rifle champion, scored 286 points out of a possible 300. And if you don't believe he can shoot, look at his coat.

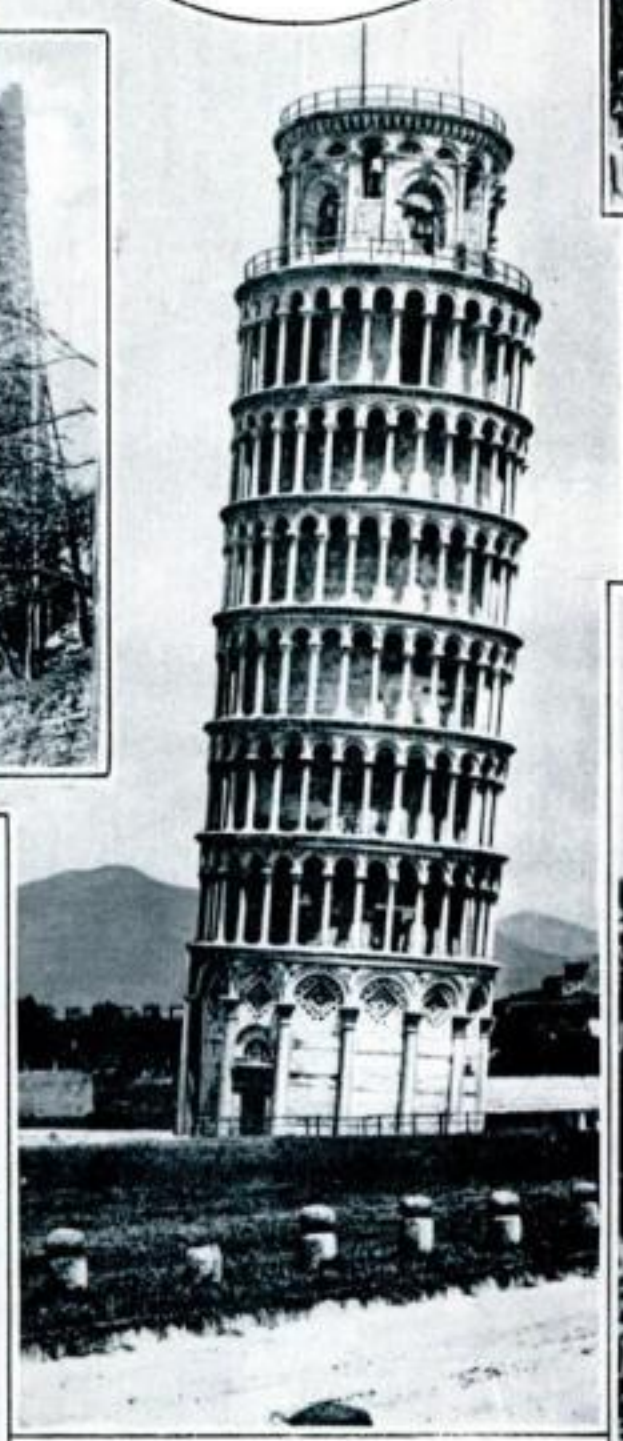
A surgeon by profession, Dr. I. R. Calkins, of Springfield, Mass., carries his steady nerves and keen eye to the target range. For many years he has been the outstanding pistol and revolver shot of the United States. Deadeye Dick wouldn't stand a chance.

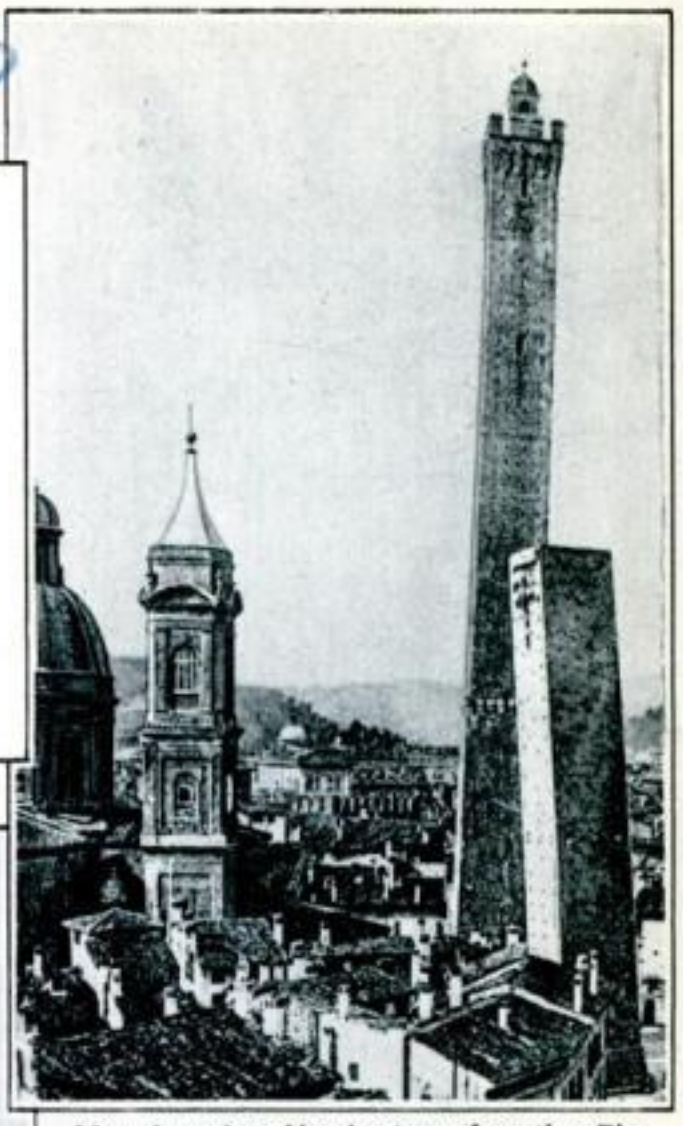
Curious Towers Bent by Time



More than 350 years after its construction, engineers are seeking a way to straighten the famous leaning tower of St. Moritz, Switzerland, pictured above. They hope to make the foundation as level as it is firm. The tower was originally part of a church, long since pulled down. The leaning tower of Bad Ems, Germany, seen at the right, is said to have been built on the foundation of the watch tower of a fort once occupied by legions from Rome.

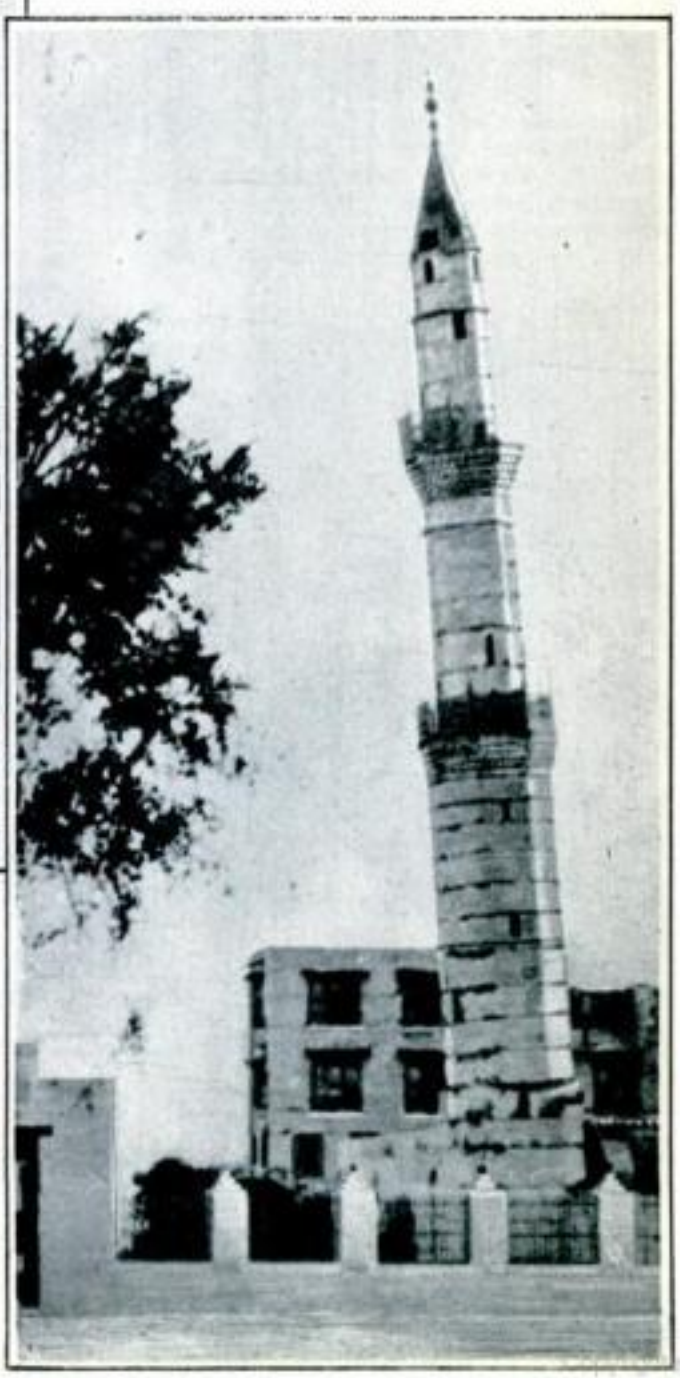






More deserving of leaning tower fame than Pisa is Bologna, also in Italy, boasting two such towers, built early in the twelfth century from motives of patrician vanity. The 320-foot tower, built by the Asinelli family, has a lean of 4 feet, not increased since the base was strengthened in 1488. The Garisenda tower, 137 feet high and eight feet two inches out of plumb, was not finished and the upper part was removed, probably to save the rest, in 1358.

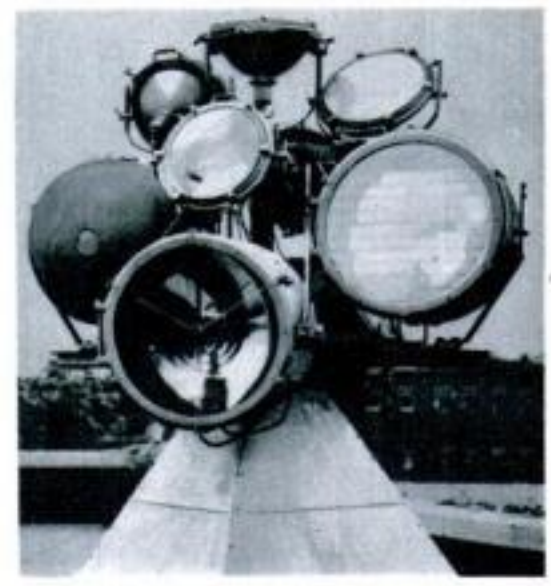
Not so tall as the others—being but ninety feet—the Butcher's Tower at Ulm, Germany (left), reminds one of the old saying by standing so straight that it leans backward, four and one half feet out of plumb. The leaning tower of Pisa, Italy (above) started in 1174 on a foundation of wooden piles only ten feet deep in soft ground and not completed until the middle of the fourteenth century, began to tilt when the third story was built. The "leaningest" tower in the world, it was 15½ feet out of plumb in 1829 and 16½ in 1910. Its present rate of "fall" is an inch in twenty-five years. The leaning minaret of Jeddah, in Arabia, the port for Mecca, is seen at the right.



With *the* Pacemakers *in* Flying

New Aerial Ambulance

Speeding a hundred miles an hour to a base hospital, wounded Marines can receive first aid treatment in this new ambulance plane—a transformed Loening amphibian. It has room for two stretchers and a field doctor. Note the wide doorway to admit stretchers.



Multiple Airport Beacon

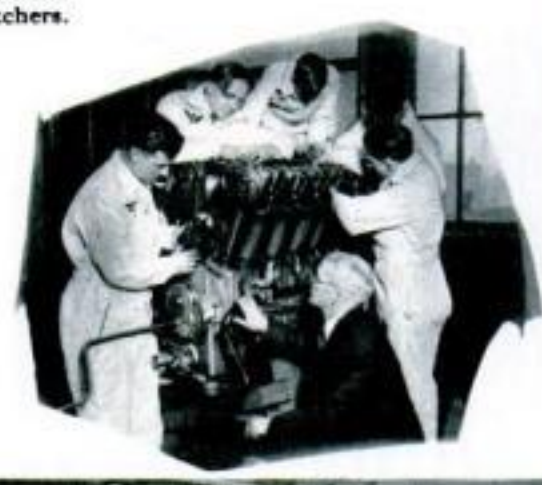
Mounted on a single standard, this mighty battery of searchlights shoots red and white beams into the sky to guide night flyers into the Cleveland Municipal Airport. The beacon is on a roof.

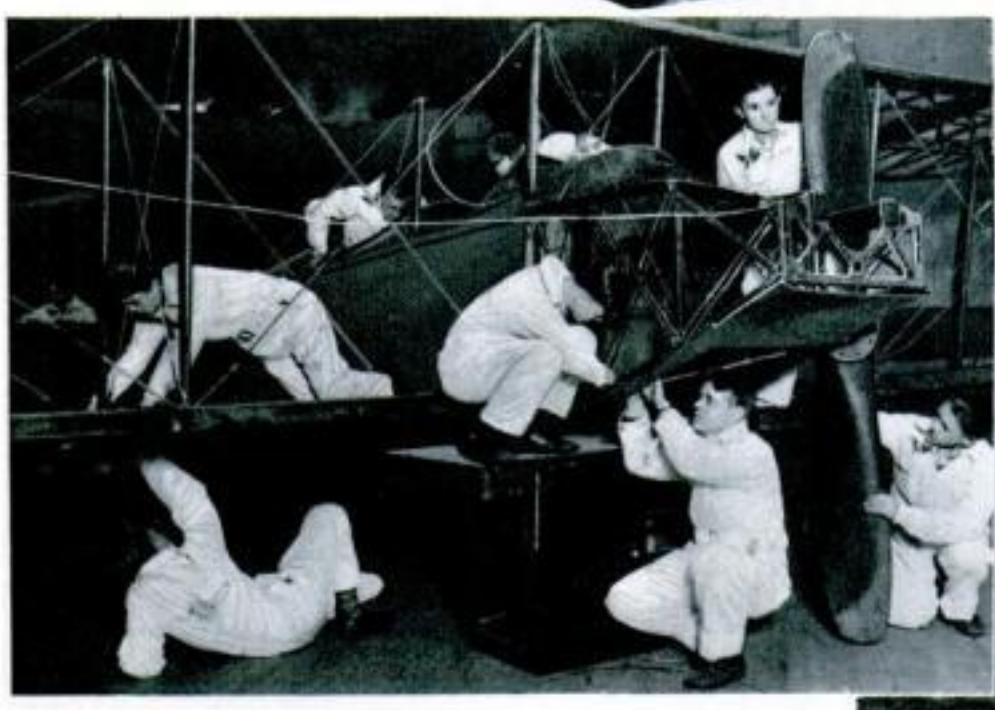
America's First "Flying Train" Goes 175 Miles

A thrilling new kind of cross-country flying was introduced in the United States the other day when Dale Drake, a Pacific Coast glider pilôt, hitched his motorless craft to a Fokker monoplane piloted by Lloyd O'Donnell, and soared for 175 miles over southern California at the end of a 500-foot rope. Near San Fernando, the towrope broke. Drake soared skillfully for ten miles and coasted to a safe landing in a barley field. Next day the "flying train"—plane and glider— took off again. The photo above shows the machines and pilots standing side by side. The top picture shows them in the air.

Aviation in High School

Working on actual planes in the classroom, overalled students in a new aviation course offered by Lane Technical High School, Chicago, master the "ground work" as well as the theory of flying. They are seen at the right assembling an airplane motor. William A. Sears, aviation instructor at the school, is at the left in the picture.





Future Pilots Assemble the Classroom Plane

When your highest ambition is to be a flyer some day, going to school on a real plane is fun and nothing but! The Chicago high school students in this picture are having the time of their lives assembling the classroom plane after they have taken it apart. By actual work on the machine they learn the secrets of wing design and construction, and other fundamentals of the game. This practical knowledge is supplemented by classroom lectures on the theory and mechanics of flight. A number of other high schools throughout the country have added aviation courses to their curricula in recent months.

San Francisco "Attacked!"

This remarkable photograph was taken during a recent demonstration by a squadron of Army battle planes of the ease with which a sky fleet might launch an attack on San Francisco. Taking off from Crissy Field, the planes, in numbered order, kept perfect formation.

American Aviation Doubles in a Year—Catapults for Airports—Great Flights and New Inventions

WITH last year's air transport mileage just double that of 1927, America has suddenly leaped forward as the world's leader in aviation. The Aeronautical Chamber of Commerce reports that airplanes, during 1928, flew 10,472,024 miles in the United States—a distance equivalent to more than forty round trips to the moon! It was a gain of more than 5,000,000 miles over the previous year, and exceeded Europe's percentage of increase four to one.

Germany now is America's nearest competitor, with more than 6,000,000 miles flown. France is third, with 4,600,000. Italy and England each flew less than two million miles.

Germany still led this country in airplane passenger travel, however, probably because of lower fares resulting from government subsidy of foreign air lines. In America, 52,934 passengers were carried, compared with 111,000 in Germany.

Nickel-Plate Wings

NICKEL-PLATED cloth is the latest airplane novelty. J. J. Mascuch, a young Newark, N. J., inventor, has developed a process by which he can actually deposit nickel on fabric, by electrical heat treatment. When plated only one thousandth of an inch thick, the cloth, although it is still flexible, becomes air-tight, it is said, and would be useful for leak-proof gas bags for dirigibles. Wood may also be treated with nickel. Thus an entire airplane, wings and fuselage, might be metal-clad at great saving in weight over present all metal planes. Nickel-plated wings could be kept ice-free by an electric current used to warm them.

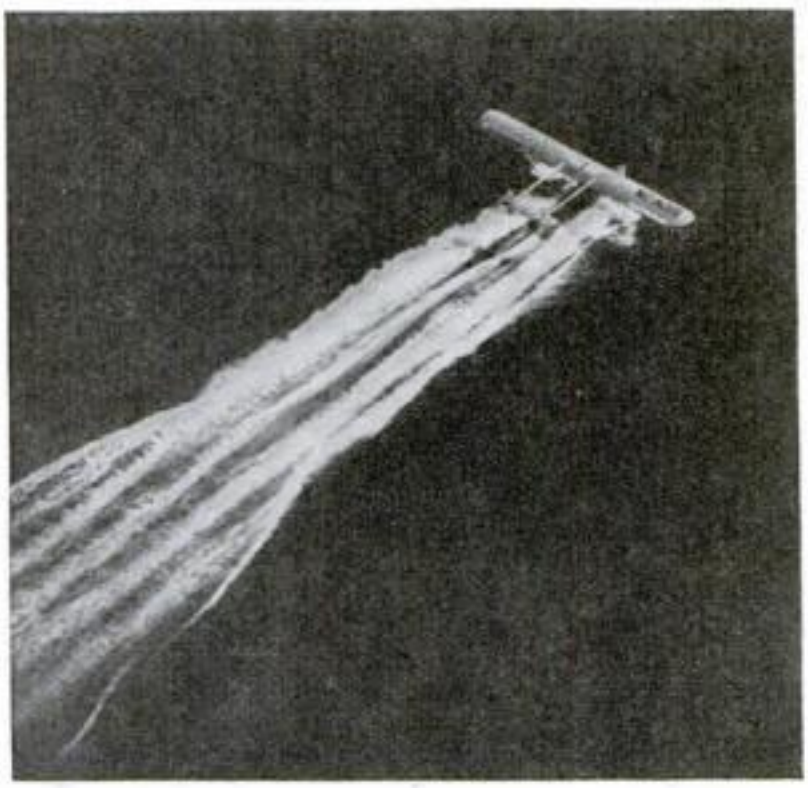
An English plane builder, S. E. Saunders, recently declared that a process recently developed abroad to make fabric strong and noncorrosive by applying a metal coating would revolutionize plane construction. Several laboratories have experimented with such processes, but they have hitherto proved too expensive to be practical.

Mascuch's first experiment was with a linen handkerchief; he coated it with nickel half a thousandth of an inch thick. He has also nickel-plated such unusual objects as peanut shells and babies' shoes.

Solo Flight Record

A "LONE wolf" of the air recently landed at Roosevelt Field, N. Y., with an endurance record all his own. The pilot, Martin Jensen, had been up for thirty-five and a half hours—longer than any other man in the world had flown alone. Previous endurance marks had been made with relief pilots taking turns at the controls, and the 150-hour record flight of the Army plane *Question Mark* at California was accomplished with a crew of five aboard.

Jensen's record was the more remarkable in that he used ordinary automobile fuel instead of the more highly refined aviation gasoline generally considered essential for airplane use. At the start his Bellanca plane was loaded with 440 gallons of the fuel. Bumpy weather aloft, he said, was all that prevented him from making an even longer record.



ELSEWHERE in this issue, two famous plane designers, Glenn H. Curtiss and Igor I. Sikorsky, looking into the future with other leaders in aviation, prophesy increased use of flying boats and amphibians, especially for travel over the seas. The photograph above gives a magnificent view of a twin-engined Sikorsky amphibian taking off from the waters of Biscayne Bay, Florida, leaving a wake of foaming white. Planes of this type may become the winged ocean liners of the future.

Catapults for Airports

THAT airports of the future may employ catapults to launch cargo-bearing planes is the novel suggestion of Major Alfred Hildebrandt, noted German flyer and air authority. Such an expedient, he points out, would be simply a return to the original gravity-power catapult used by the Wright brothers to give their early planes a "running start."

"Much fun was poked at the catapulting arrangement of the Wrights," he says, "but as a matter of fact, after twenty-five years, we are now discussing the reintroduction of some such artificial starter. It would be used both to enable heavily-laden planes to take off easily, and to aid starting on smaller airdromes.

Revolutionary Cooling

A REVOLUTIONARY liquid for cooling airplane motors has been developed by the U. S. Army Air Corps at Wright Field, Dayton, O. As announced by the War Department, it is ethylene glycol, a chemical employed as a base for many antifreeze solutions. Used instead of water in radiators of water-cooled engines, it is said to eliminate more than a hundred pounds of needless weight, increasing a plane's pay load and its speed.

Four and a half gallons of the new fluid replace eighteen gallons of water—a saving of eighty-four pounds. But this also reduces the size of the radiator required and means a further saving of some forty pounds. Also the air resistance of the radiator in flight is diminished, speeding up a plane as much as eleven miles an hour.

Further consequences of its use may be that streamlined radiators may be placed in the wings of a plane, and that oversize water-cooled motors may replace present engines with no increase in weight.

The liquid is clear, colorless and odorless, and its constituents may be obtained on the open market at comparatively low expense. It boils at about 400 degrees F.—considerably hotter than boiling water. This feature permits water-cooled planes to operate at higher speeds.

Spain-to-Brazil

THE year's first trans-Atlantic flight ended in brilliant success when Ignacio Jiminez and Francisco Iglesias, Spanish aviators, landed their plane on the northeast coast of Brazil. They had completed a nonstop flight of about 4,000 miles from Seville, Spain.

Fear for their safety during the 36-hour crossing, in which they were sighted by no ships, was quickly dispelled when they taxied down upon the aviation field at Bahia after a trip at an average speed of more than 100 miles an hour. This made the seventh time the South Pacific has been crossed by airplane, two previous flights having been nonstop—those of the French aces, Costes and Lebrix, and of the Italians, Ferrarin and Del Prete. The latter flight, of 4,400 miles from Italy to Brazil, was the longest nonstop hop ever made.

"I Was Almost Cannibal Stew!"

Famous Explorer-Photographer Describes How It Feels to Miss Death by Inches at the Crank of a Movie Camera—His Amazing Escapes from Charging Beasts

When Martin Johnson brought down a charging rhino. He tells here of a tragic adventure with these fierce jungle animals.

By

MARTIN JOHNSON

as told to
Fitzhugh Green

Passing out the cigars. The famous explorer-photographer makes friends with a savage Swahili chief and wife, in British East Africa.

WHEN we landed on the north beach of Malekula, one of the New Hebrides Islands in the South Pacific Ocean, we heard the weird music of a distant *boo-boo*, or gourd drum. This meant a cannibal feast was in progress.

"Bring the camera! Hurry!" I told my native guide from Vao who claimed he'd once visited this dangerous tribe of man-eaters.

But the guide hung back in fear.

"Not now, White Man. Listen! The *boo-boo* drum! We shall be but *long pig* for their feast!"

"You desert me now, you black coward, and you'll be long pig for my feast!" I warned him.

The wretched guide's eyes dilated with terror. So the White Man was a cannibal, too!

But the bluff worked. We went on; cautiously, for I knew there was real danger. We came to a small clearing. In its center was a fire around which moved rhythmically a circle of naked aborigines. With long spears and a savage chant they kept time to the ceaseless booming of the *boo-boo*.

Trembling in every limb, my guide set up the camera. Though we were concealed from the cannibals by a lacework of green leaves, he was sure we should be discovered and massacred, so that our flesh could be added to that I knew was roasting on the fire.

I focused, cranked, shifted film, and cranked again. And all the while I was doing this the unearthly noise of the cannibals kept up.

Suddenly a wild desire to climax my film assailed me. It was not courage; it was the natural instinct of the born movie maker.

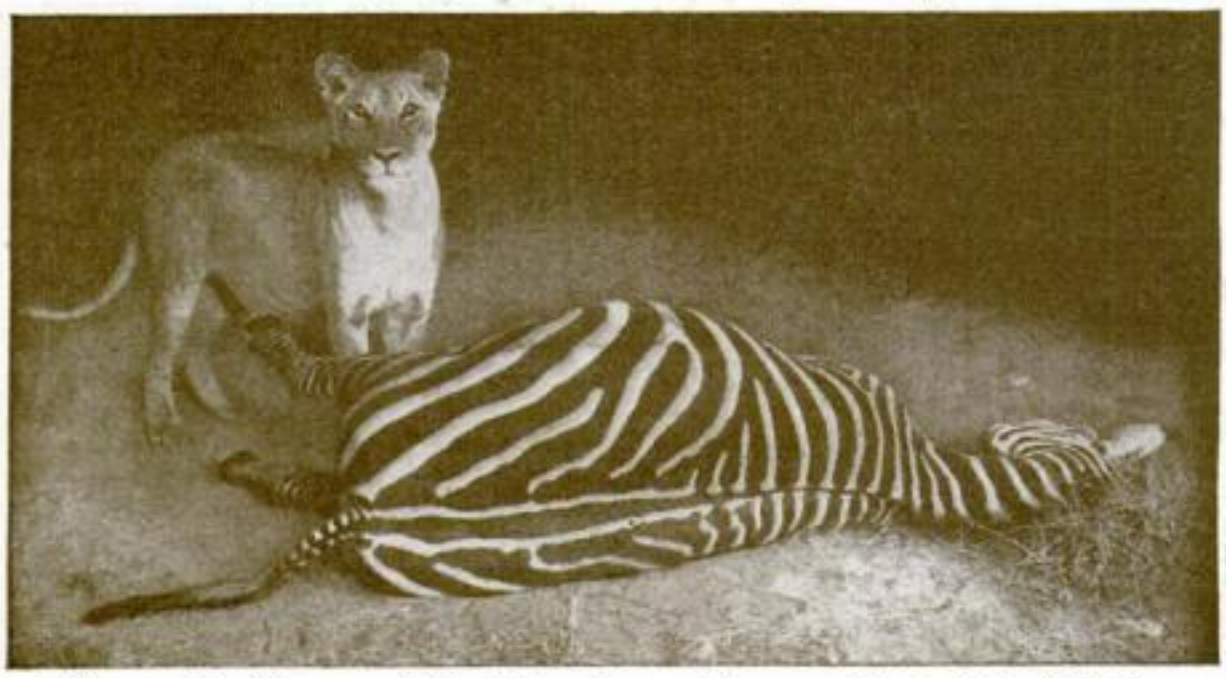
Before my companions could stop me I yielded to my sudden impulse. I sprang from our hiding place, carrying my camera over my shoulder, and rushed toward the cannibals. I was not even surprised when they fled shrieking into the jungle, pursued by what seemed to be a two-headed man with white skin. I set up and cranked again. Then I looked closely into the fire.

A sickening sight met my eyes: there, broiling on green stakes thrust into the ground, was a human head with leaves plugging its eye sockets!

I was young then. I took chances I'd never take now.

Of course, we beat it before the cannibals came back to find out what sort of devil had broken up their feast. But I was determined to know them better.

Foolish move, too. "Don't think you can get away with anything in dealing with cannibals," Jack London had warned me a few years before, when he and I had cruised among these waters in the little *Snark*. "Remember, Martin, the cannibal is always thinking of you in terms of his next meal."



A lioness and her kill—a remarkable nighttime close-up of the queen of the jungle, for which Johnson risked his skin. Startled by the flare of the flashlight, the beast looked up, straight into the camera.

WE NOW camped down the beach a few miles away. At night we anchored off so we wouldn't be ambushed. Next day the cannibals began to arrive. They were curious, but cautious. The chief, Nagapate, was a powerful black with a cruel mouth and wicked eyes. When I gave him calico and beads he invited us to his village.

The Vao guide absolutely refused to go. Said I could kill him and eat him if I wished. That was better than being tortured first the way Nagapate would do it. Not pleasant news, I assure you.

Over a winding trail we mounted the plateau on which the village was located.

After dealing out more calico and beads, I set up my camera. Nagapate seemed to think the devil in my black box had to be propitiated. So he ordered a dance.

I was lulled into a sense of false security by his hospitality. No one had ever taken movies of cannibals. I was doing it! I exulted in thoughts of the triumph I would have when I got home.

Suddenly Nagapate shouted a sharp command. The dance ceased. Before I could let go my crank a circle of two hundred armed savages began to close in upon me. I could see the flesh-lust in their evil eyes.

THERE'S no use denying it, I was scared. It must have been an act of Providence that saved me. I didn't reason it out. Just before it was too late I seized my entire store of trading material and tossed it into the midst of the cannibals. Instantly a wild scrimmage for the spoils broke out. The oldest warriors lost their dignity, and plunged into the mêlée with the rest. Even Nagapate was swallowed up in the dirt and struggling bodies.

I seized my camera and ran for my life. Before I had gone a hundred yards, I could hear the noise of pursuit. But my few seconds' start were enough. I made the boat in a state of collapse.

Next day Nagapate brought his army to the attack. The humiliation of being twice outwitted by the white man was probably too much for his pride. But when the howling savages lined the beach and brandished their spears in our direction we were too far out for them to reach. Luckily they were not canoe users.

And then, incredible as it may sound, my photographer's instinct still again got the better of me! Once more I risked my life and the lives of my little party to match my film against the cannibal's wit. I knew that while they would not respect me, their fear of the Powers of Darkness was stronger than life itself.

AS I expected, toward evening Nagapate and his mob disappeared in the direction of their village to get their evening meal of half-cooked pig. Soon as they were out of earshot I hustled my little party ashore. On the beach I set up a white canvas screen and propped my projector with lumps of coral. By the time Nagapate's men came creeping down the trail I was ready.

I waited until the cannibals literally surrounded me. (Continued on page 151)

The herd of elephants, photographed a moment before they charged. Johnson's procedure was "to get film and save our lives afterward."

The bull elephant preparing to charge. "At the first whiff of my scent his ears spread wide and his mighty feet shifted in irritation."

A pack of hyenas photographed at their midnight feast. Though they have enormously powerful jaws and claws, these night prowlers are noted for their cowardice.

The lion which charged Johnson. "Scarcely had I started to crank than the beast began to advance. His tail was flipping violently. Now and then he gave a roar."

A herd of giraffes drinking at a water hole on the Chobe plains in the northern frontier district of British East Africa. This is one of the many remarkable photographs of African big game in its native haunts made by Martin Johnson during his four years of exploration in this wild region.

Leonardo da Vinci, from a portrait painted by himself, in the famous Uffizi galleries in Florence.

"Da Vinci Did It First"

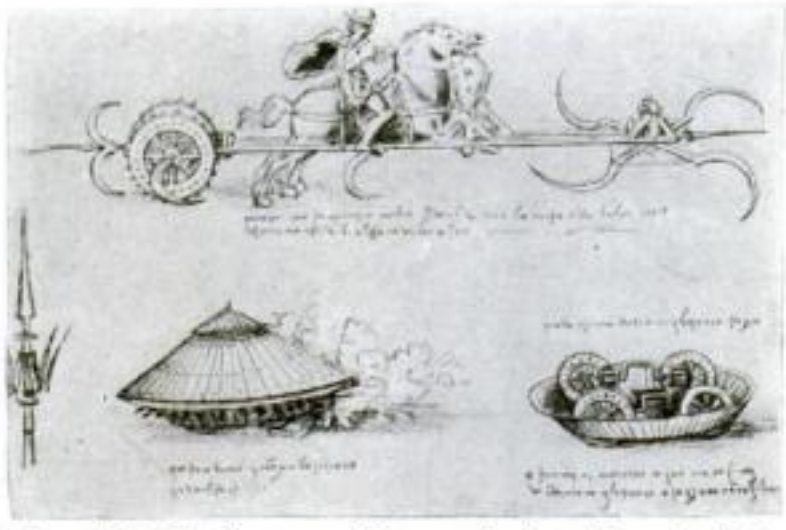
The Story of an Amazing Genius Who Devised a Flying Machine and Other Modern Wonders Four Centuries Ago

By EDWIN W. TEALE

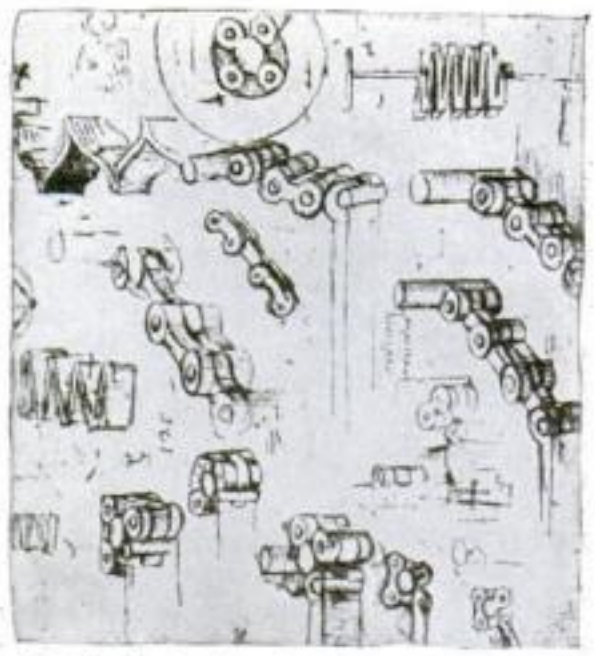
THE whir of the Byrd and Wilkins airplane propellers in the Antarctic in recent months has directed fresh attention to a remarkable genius of four centuries ago. When alchemy and astrology were still regarded as exact sciences, he designed a flying machine embodying principles used in present-day aircraft and invented the propeller, and when others had barely ceased thinking of the Straits of Gibraltar as the Portals of the Unknown, he included Antarctica in his map of the world!

All of us know Leonardo da Vinci as the painter of "Mona Lisa," "The Last Supper" and "La Belle Ferronière," the painting over which such a furious controversy has been waged recently, as told last month in POPULAR SCIENCE MONTHLY. His fame as a painter has obscured his reputation as a great trail blazer of science. Yet he stated scientific laws that four centuries of experiment have not altered, and many of his simplest inventions have become part of our daily lives. The spiral spring hinge that shuts your screen door is a product of his mind. He invented the wheelbarrow, the rotating smokestack that turns with the wind, the flexible roller chain used on bicycle sprockets and in other chain-drive mechanisms.

Every child in school, doing problems in addition and subtraction, is helped by this genius of long ago, who is said upon competent authority to have devised the plus and minus signs used the world over!



Two of Da Vinci's war machines—a chariot with mechanical swords and a man-driven predecessor of modern armored tanks.



Da Vinci's drawings for his invention of the flexible roller chain, used today on bicycle sprockets and other chain-drive mechanisms.

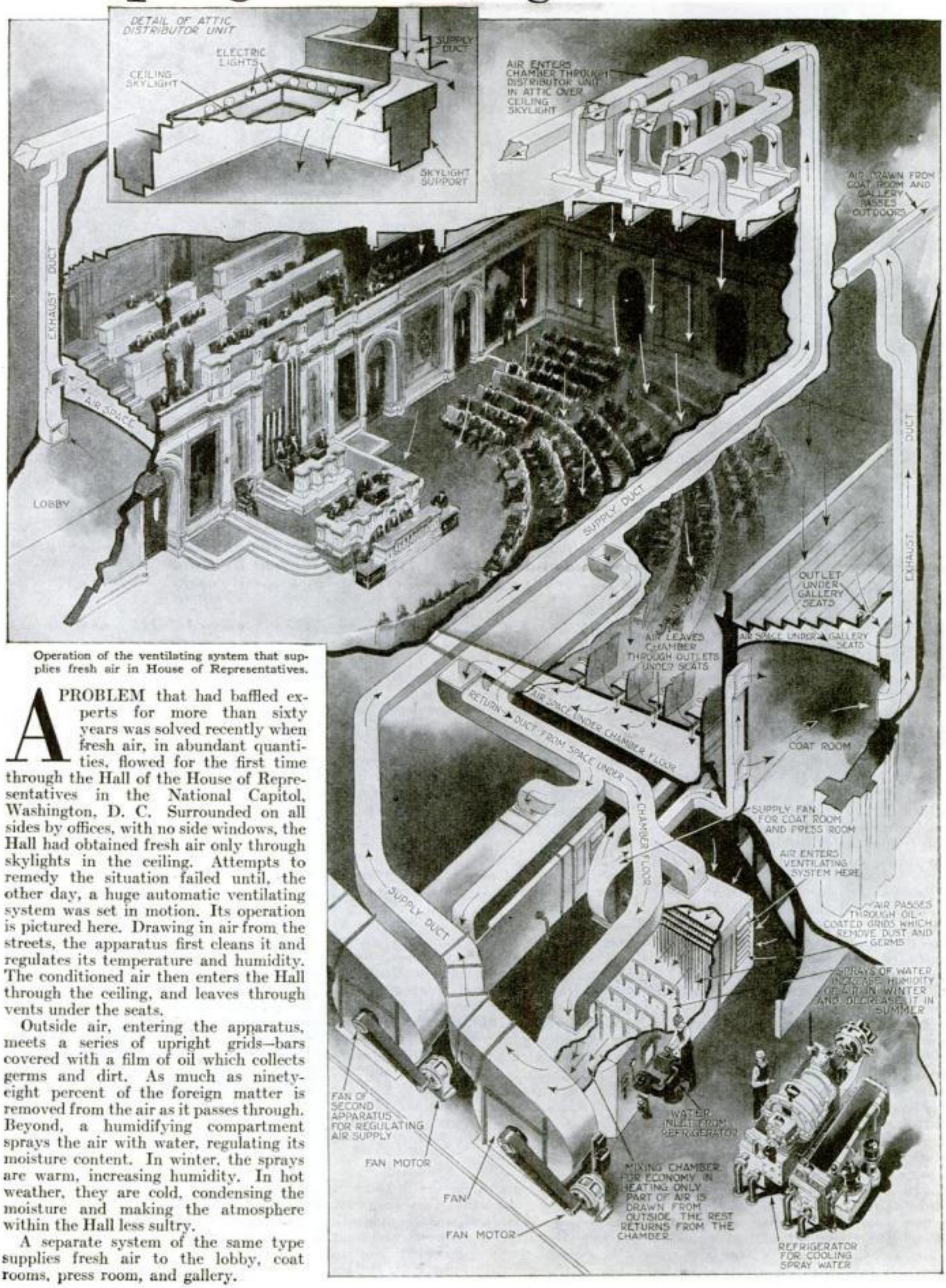
Leonardo was born in 1452 in a fortified hill village in Tuscany, Italy, the son of a Florentine notary. A strong, amiable, beautiful child, he early showed a gift for music and drawing. At seventeen, he became the pupil of the famous artist, Andrea del Verrocchio. A year later, Verrocchio allowed him to paint a single angel in a large picture of "Christ's Baptism." So superior was this small bit of work that, according to the story, Verrocchio acknowledged the genius of the eighteen-year-old boy by laying down his brushes and never touching them again.

For the next ten years, Leonardo painted under the favor of Lorenzo the Magnificent, in Florence. His days were spent in incessant painting and study. They were too full of work for roistering, and he led a singularly upright life in the dissolute court. His physical strength was so great that he could bend iron bars over his knee and twist horseshoes. He rode unbroken horses for sport and is said to have been able to disarm any adversary and to have had no equal in running, wrestling, and swimming. Yet his nature was so gentle that he used to go about Florence buying caged birds in order to give them their freedom.

WHILE he was winning recognition as a painter, sculptor, and architect, his active mind was seeking "the soul of things" in all branches of learning. He kept lists of people who possessed knowledge, and of books he wished to consult, and made long journeys to see them. In his manuscripts are often such notes as: "A grandson of Angelo the painter has a book on water which belonged to his father."

The most gifted and brilliant man of his age, he worked harder than anyone around him. His oft-repeated maxim was: "Stagnant water loses its purity, even so does inaction sap the vigor of the mind." Leonardo never published a line. But when he died, thousands of pages of manuscript, which had accumulated during his life, recorded the harvest of his active intellect. Because he wrote from right to left in the Oriental manner, these manuscripts (Continued on page 148)

Keeping the Congressmen Cool



Operation of the ventilating system that supplies fresh air in House of Representatives.

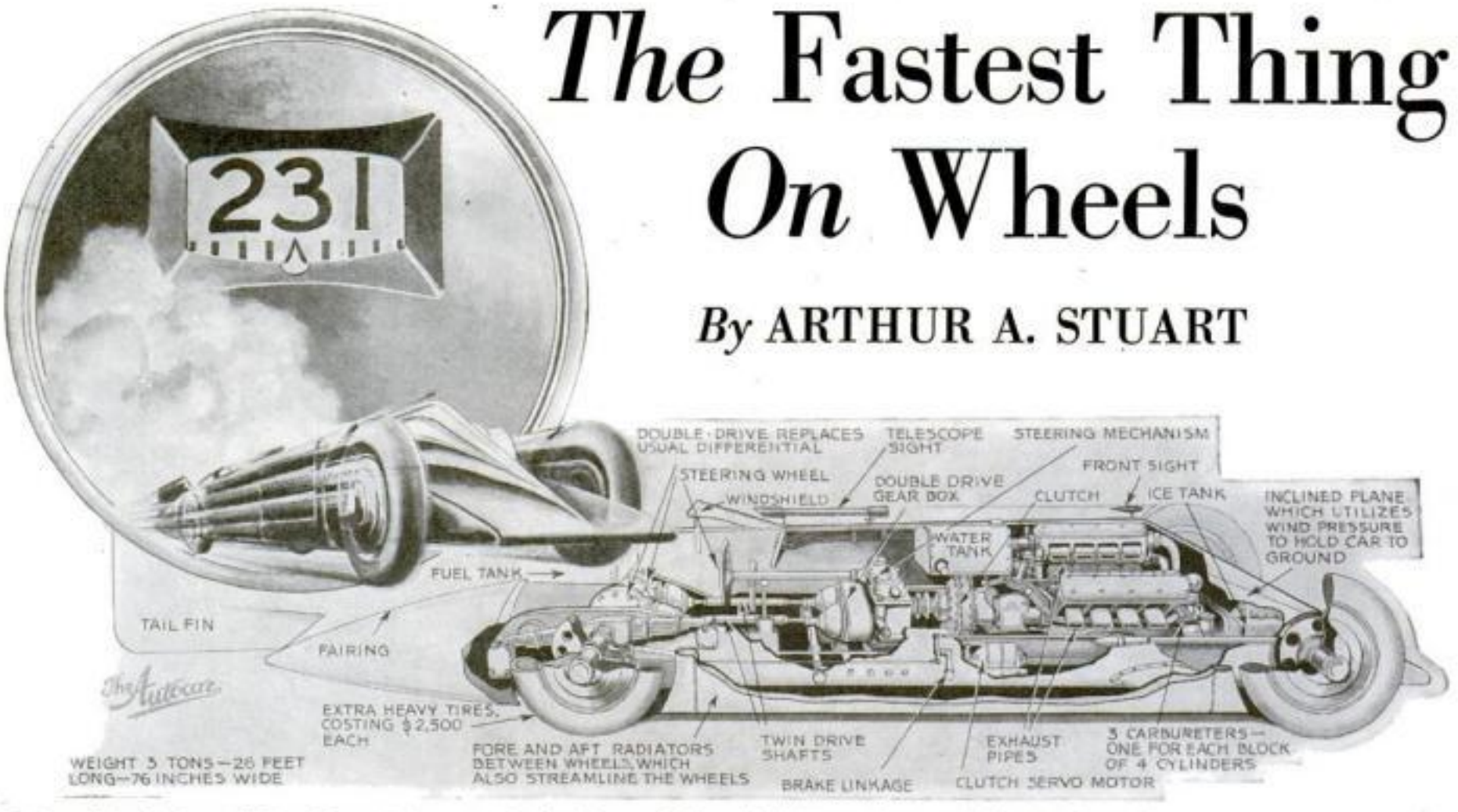
A PROBLEM that had baffled experts for more than sixty years was solved recently when fresh air, in abundant quantities, flowed for the first time through the Hall of the House of Representatives in the National Capitol, Washington, D. C. Surrounded on all sides by offices, with no side windows, the Hall had obtained fresh air only through skylights in the ceiling. Attempts to remedy the situation failed until, the other day, a huge automatic ventilating system was set in motion. Its operation is pictured here. Drawing in air from the streets, the apparatus first cleans it and regulates its temperature and humidity. The conditioned air then enters the Hall through the ceiling, and leaves through vents under the seats.

Outside air, entering the apparatus, meets a series of upright grids—bars covered with a film of oil which collects germs and dirt. As much as ninety-eight percent of the foreign matter is removed from the air as it passes through. Beyond, a humidifying compartment sprays the air with water, regulating its moisture content. In winter, the sprays are warm, increasing humidity. In hot weather, they are cold, condensing the moisture and making the atmosphere within the Hall less sultry.

A separate system of the same type supplies fresh air to the lobby, coat rooms, press room, and gallery.

The Fastest Thing *On* Wheels

By ARTHUR A. STUART



Design and mechanism of Major Segrave's $170,000 *Golden Arrow*, which enabled it to attain a speed of 231 miles an hour.

A FRIGHTENED little woman sat in the grandstand, strangely silent. Across the sand below her streaked a human bullet. She covered her eyes. It was her husband, racing against time in the fastest motor car on earth. His chance of emerging alive, he had figured, was one in ten. The bullet flashed by—and here is the story of how it hit an almost incredible new speed mark.

FAR down the tawny strip of sand that borders the ocean at Daytona Beach, Florida, a tiny speck appeared. A faint buzz swelled to a roar. A blurred outline shot past—a man in a 1,000-horsepower car, going nearly four miles a minute. Fifty thousand spectators roared encouragement the driver could not possibly hear.

Major H. O. D. Segrave, daring Britisher, in the strangely streamlined *Golden Arrow*, had hung up a new automobile record of 231 miles an hour—twenty-four miles an hour faster than any man ever had traveled before on the surface of the earth.

Can you imagine going at that speed? If Segrave's car, traveling that fast, had hurtled off a platform inclined at forty-five degrees, it could have leaped the width of the St. Lawrence River at Quebec, in a broad jump two thirds of a mile long. Had the imaginary platform been tilted about ten degrees higher, Segrave and his car would have zoomed upward in a high jump that would easily have taken them 100 feet over the Eiffel Tower in Paris, 984 feet high! At 231 miles an hour, Segrave was moving nearly twice as fast as would the body of a man when it struck the ground after falling from the top of the Washington Monument.

Such was the staggering speed the *Golden Arrow* attained. Twice Segrave made a human bullet of himself, once each way over the one-mile course. The official time recorded, 231.36 miles an hour, was the average of two laps, one each way over the course. As a matter of fact, however, the time on each lap was approximately the same. Steaming water was hurled into his face from a broken radiator tap. Repeatedly, there were sickening swishes as his tires ripped through dangerous wet streaks of sand. Only by aiming the three-ton car, equipped with rifle sights, at red arc lamps, strung along the course, could Major Segrave guide the machine. One of these sights, equipped with crossed wires, was on the nose of the car, the other, a naked sight, was just in front of the driver.

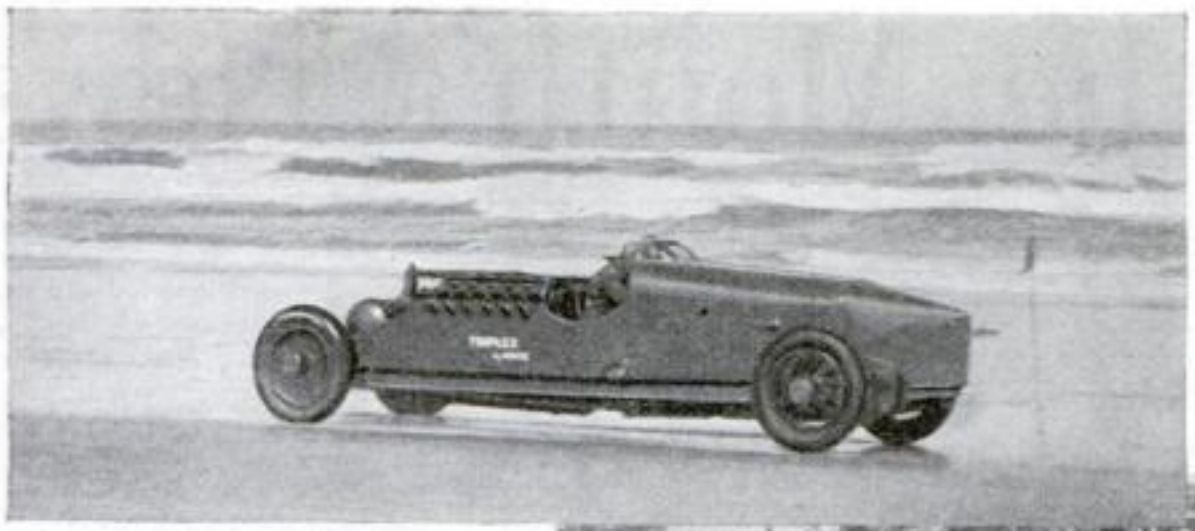
Before he started, he told reporters that he had but one chance in ten of emerging alive. And, afterward, he announced that he would never race again. Once before he had declared he was through with auto racing. That was in March, 1927, after he had set a 203-mile-an-hour mark in his *Mystery S* car at Daytona. That achievement had climaxed a career devoted to racing which started in 1919, after Segrave had served in the infantry, machine gun, and aviation branches of the British army during the war. In 1922 he won a 200-mile race in London, then next year the French grand prize at Tours. In the following months he raced in Spain, Switzerland, and other countries and earned new laurels.

AFTER his record in the *Mystery S*, everyone thought that Segrave, thirty-two and married, was through with racing. But English engineers who built the *Golden Arrow* persuaded him to drive it this year to win back for Britain the speed record that America had captured since his retirement. To do it, he ran risks that he had never braved in all his spectacular past.

AT A speed of 231 miles an hour, ordinarily gentle air delivers a hammer blow. Contrast it with a ninety-mile gale and you have some idea of its force. Had Segrave ventured to extend his head outside the shielded cockpit, his neck would have been broken instantly. The front of his car bucked an air resistance of more than four *tons*—and more than half of the motor's thousand horsepower went to overcome this force alone.

If a tire had blown, Segrave's car would have been hurled through the air, probably causing his death. When Frank Lockhart's *Black Hawk Special* suffered a punctured tire in a Daytona speed test last year, the car somersaulted and crushed that brilliant young racing driver, killing him instantly. To avert a repetition of such a tragedy Segrave did not rely on the ordinary four to six-ply tires, but brought with him from England thirty fourteen-ply tires, carefully built at a cost of $2,500 apiece to last the fifteen-odd seconds it took him to cover the mile course. No tire could stand such a pace longer, and Segrave changed the whole set of four before his second run. The treads of the first set were torn, the strain of fifteen seconds at that speed being all rubber and fiber could stand.

Before each of his record runs Segrave filled a box in the tapered nose of his car with crushed ice to cool the blistering motor. In first speed or "low gear" the



A race that death won—Lee Bible roaring down Daytona Beach in J. M. White's *Triplex*, in an attempt to beat Segrave's record. At 200 miles an hour he lost control and crashed into a sand dune.

car traveled ninety-nine miles an hour. The twelve-cylinder motor with the cylinders arranged in three banks would consume seventy gallons of super-refined gasoline in an hour. A huge fixed rudder or tail fin at the rear brought the car back on its course whenever a depression in the sand huried it into the air.

The *Golden Arrow* itself is low-hung, being at points about six inches from the ground. The graceful streamlined racer resembles more the fuselage of an airplane than it does the body of a conventional car. In fact, it was patterned after the fuselage of the airplane *S-5* which won the Schneider cup for speed at Venice last year.

THE *S-5*, by way of comparison with Segrave's speed, made 318 miles an hour, but only a plane could have outdistanced Segrave's machine. He would have shot by Herr Opel's rocket car, capable of 156 miles an hour on railroad tracks, as if the latter were standing still. The world's speed mark for locomotives is said to be held by an experimental electric locomotive in Germany that made only 120 miles an hour. Steam locomotives make, at best, only about a hundred. Power boats trail behind, their record speed being ninety-four miles an hour.

In the *Golden Arrow* some engineers see more than a hint of the fast automobiles of tomorrow. These may take on more and more the appearance of airplanes, even though they do not leave the ground. That the science of aerodynamics will play a large part in the future of the automobile is freely predicted.

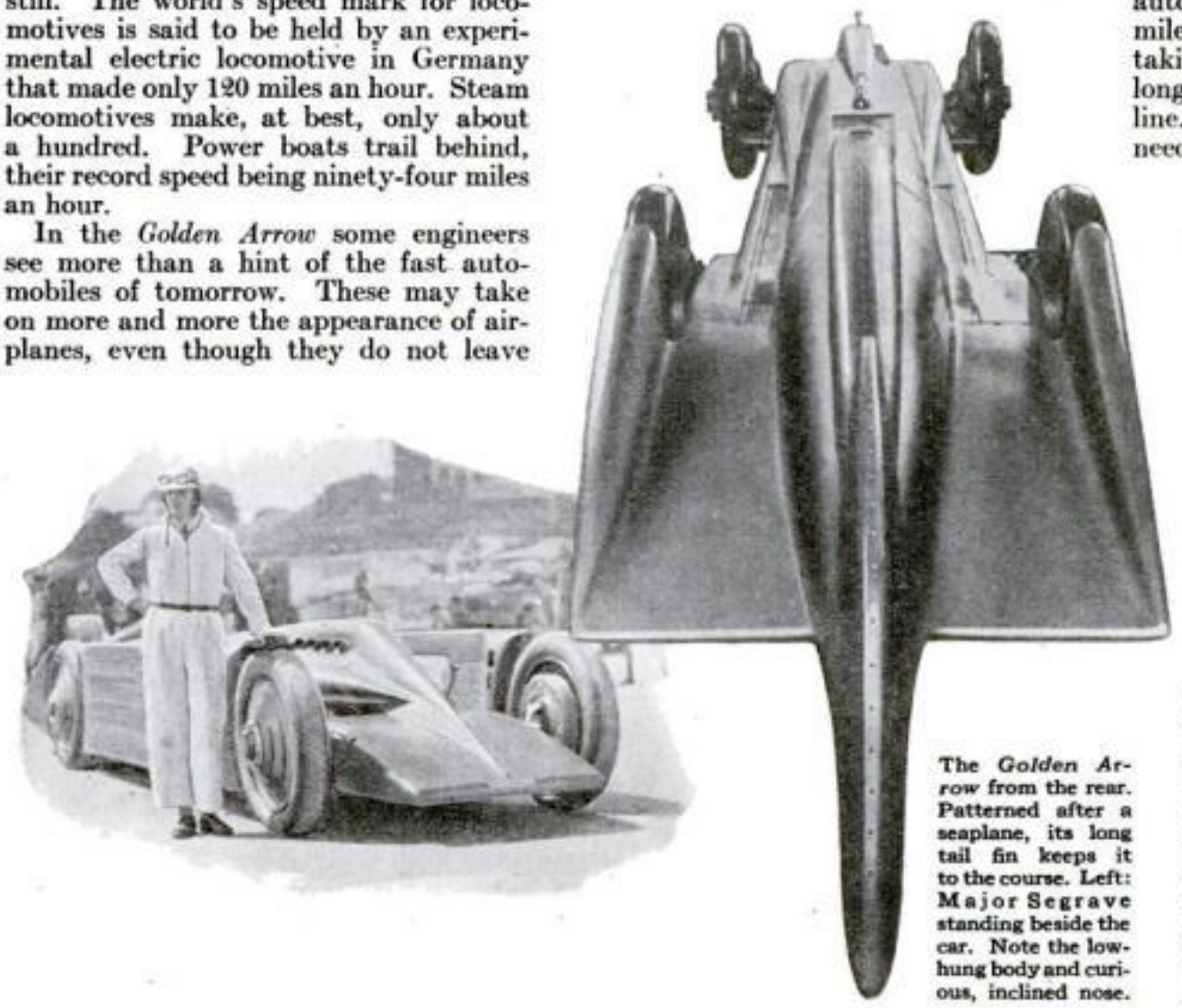
Capt. J. S. Irving, British designer of the *Golden Arrow*, foresees steel-tired juggernauts of 400 mile speed, and engineers say there may be no practical limit to speeds that cars may eventually reach save that of their roadbed! No one knows, today, the human speed limit—that is, the speed which an automobile driver can survive. But most experts agree that speed alone, so long as it is not jerky, has no direct physical danger. Apparently the driver can keep pace with the car.

All that was left of the seven-ton *Triplex*. Bible met instant death, as did a camera man standing in the path of the car.

WILL Segrave's record stand? Most observers believe it will for some time to come, though Segrave thinks that the *Golden Arrow* could attain a top speed of 240 miles an hour. The only other car with any chance of such a record—the seven-ton *Triplex* built by J. M. White, Philadelphia sportsman—reached what may have been its limit when last year, driven by Ray Keech, it set the 207½-mile record that Segrave broke.

This year, shortly after Segrave made his new mark, Lee Bible, a Daytona mechanic, raced the *Triplex* in an attempt to wrest the record from the Britisher. At a 200-mile speed, the machine swerved and crashed into a sand dune. Bible and a camera man standing in his way were killed. Some experts said that the fault lay in the car's design, making it difficult to control at such a velocity. It was not streamlined, and depended on brute power for its speed. Segrave suggested, instead, that Bible may have released the speed control suddenly when he found himself veering away from the course, toward the sea. At a 200-mile speed, the sharp decrease in velocity might easily have sent the car out of control. Segrave required a three-mile run to bring his own car safely to a stop after covering the mile course, and as long to bring it up to speed for the start.

The speedway at Daytona Beach is probably the only one in the world where Segrave could have made his record. For automobiles that travel better than 150 miles an hour there is no possibility of taking curves. A runway twenty miles long is required, straight as a surveyor's line. A beach of hard sand fulfills the need. Europe's only beaches are dotted with sand dunes. Only Daytona Beach, Florida, in all the civilized world, fulfills the necessary conditions. Here the American Automobile Association lays its timing wires—a pair of thin wires stretched across the sand at a two-inch height, placed a mile apart. These operate an electric recorder when a car's wheels strike them. Segrave, by maneuvering to hit the wires despite their near-invisibility, managed to hang up his world mark.



The *Golden Arrow* from the rear. Patterned after a seaplane, its long tail fin keeps it to the course. Left: Major Segrave standing beside the car. Note the low-hung body and curious, inclined nose.

SUPER-SPEED tests, and auto races—are these "objectless"? The modern pleasure and business automobile is the best answer to that, declares Ernest N. Smith, general manager of the National Automobile Association. It owes its balloon tires, its small multi-cylindered engine, in fact three fourths of all its present refinements, to the gruelling tests of the race track. For this reason the A.A.A., he announces, will continue to sanction high speed driving.

Back of the Month's News

By

KARL VOOGHT

THE bird that adorns the silver dollar is not the savage robber of the air people have believed him to be, but a model citizen. Dr. Francis H. Herrick, professor of biology in Western Reserve University, Ohio, recently announced this conclusion after spending five years studying the daily life of bald-headed eagles from an observation post atop a hundred-foot steel tower, overlooking a nest on the shore of Lake Erie.

Benjamin Franklin is said to have called the eagle "a bird of bad moral character." Most people of his time, believing that it stole lambs and even babies, agreed with him. For 150 years no systematic study had been made of the food and domestic habits of the eagle. When Dr. Herrick finished his work he had proved that the eagle is guiltless of many crimes attributed to it, that it carries off few chickens, probably no turkeys, and certainly no lambs nor children, and that it never attacks man without provocation.

Male and female eagles mate for life. Working side by side, they keep house in the same nest year after year. The mother bird lays two—or at most three—eggs each season, and the father bird takes his turn sitting upon them.

Every spring they add to their nest a new layer of sticks, cornstalks, straw, and pine boughs, thus enlarging it about three inches a year. Some of the sticks they carry through the air are more than six feet long and two or three inches thick. These they usually pick up from the ground. Sometimes, though, the huge birds, often seven feet across the wings, have been observed to fly against the dead branch of a tree, seize it with both talons, and break it off by sheer force. Often they carry whole cornstalks, still bearing the yellow ears, to the nest. Once a bird was seen flying home with twenty-five feet of rope dangling from its talons!

THE nest observed by Dr. Herrick was thirty-six years old. It rested in a treetop eighty-one feet from the ground, weighed two tons, and was twelve feet high and eight and a half feet across the top. This width allows the eaglets to stretch their wings in short hops before they take off for their first flight, which often covers a mile. When eight weeks old they exercise by lifting six-foot sticks.

Bald-headed, or American, eagles are found only in North America. As a rule, eagles live long. A golden eagle in Vienna, Austria, lived for 104 years in captivity. However, the number that reach maturity is small, because of their many enemies.

Remarkable photographs of American eagles in their nest, taken by Dr. Francis H. Herrick from his observation tower. Above: Mother eagle feeding her two nine-weeks-old eaglets, bill to bill. At right: A closer view of the magnificent bird, pausing for a moment after bringing in a fish for her youngsters' meal.

It has been estimated that if a pair of eagles hatch out two eaglets a year for fifty years, only one pair of the young birds will reach maturity. During the last century American eagles have decreased in number until today they are almost extinct.

Towers of Mystery

WHEN the Schneider Cup Race for speed planes is run off in England next September, many a spectator will inquire curiously about a huge floating tower that will mark a turning point of the course—and few can tell him what it is. A six-sided affair of concrete, it rears itself in steps 130 feet above the water off the eastern end of the Isle of Wight, where it replaces the old Nab lightship.

For long the secret of this "mystery tower" and of others like it has been closely guarded by the British Admiralty. Even today few Britons know of their existence. They call to mind other towers of mystery that have startled public imagination with reports of artificial thunderbolts, "death rays," and fantastic experiments with ultra-powerful scientific instruments.

During the war the British towers were secretly assembled, on a little-frequented beach, to be floated into the water at high tide. Rumor said they were to be used in defense against submarine invasion of the English Channel. Now their real object is said to have been the raising of torpedoed ships from the sea bottom in as much as twenty fathoms of water. In shallow water, two towers with hawsers between would be partly sunk by admitting water to inner chambers, then pumped out to lift the ship between them. In deep water the entire tower would be submerged. Its top bore an observation chamber. The first was completed just after the Armistice was signed.

A BLAST of dynamite destroyed America's most famous mystery tower, "Tesla's Tower," at Shoreham, Long Island, N. Y., in 1914. No one knows why, or who set it off. It had been about half completed, at a cost of three quarters of a million dollars. From its mushroom-like dome, Nikola Tesla, electrical inventor, planned to hurl electric current of millions of volts into the earth. It was a part of his revolutionary scheme to transmit power without wires to every corner of the earth. Tesla announced only last November exclusively in POPULAR SCIENCE MONTHLY that within three years he expected to complete a new electric tower.

Here and there about the world, strange towers still carry on the fascination of mystery. Only recently a monster pyramid that a millionaire writer is erecting in the Ozarks, at Monte Ne, Ark., was revealed to be a crypt for records of twentieth century civilization to be preserved for generations thousands of years hence. A different sort of mystery structure is the futuristic-patterned "Einstein Tower," at Potsdam, Germany, where wonderful instruments are testing Einstein's latest theories of time, space, and a "four-dimensional" world.

The New Paper Money

FOR many weeks, the presses of the U. S. Bureau of Engraving and Printing, in Washington, D. C., have been running night and day, turning out a new type of paper currency, two thirds the size of that now in use. The bills—a thousand tons of them—will be distributed in July to replace the 900,000,000 pieces of paper currency now in use.

The new size allows twelve bills to be made from a sheet that produced only eight before, thus saving the Government huge annual sums. The smaller bills also

can be carried in pocketbooks without folding, so that the money, which usually wears out at the creases, will last longer.

Ever since the time when cattle was wealth, the tendency has been to seek smaller and more easily carried objects to represent value. In early civilizations, the buyer drove his ox to market and exchanged it for what he bought. Ten sheep were equal to one ox in ancient Rome; and Homer, the early Greek poet, in his Iliad, speaks of the value of warriors' armor in terms of oxen.

Later, smaller objects of value were used in trading. The Fijians used whale's teeth; the Indians, wampum, made from shells. Tribes in the South Sea Islands utilized red feathers for money. Dwellers in early Scotland are said to have used iron nails in place of currency.

The first real coins are believed to have been cubes of gold made by the Chinese. The flat, round shape of our coins came from the Greeks. After experimenting with square, hexagonal, and octagonal shapes, they found round coins best. At the end of the eighteenth century, silver was the chief form of money. At present, gold is supreme. In the future, some entirely different substance—a speaker before the American Chemical Society says it will be nitrogen—may form the world's basis of wealth.

When the new bills appear in July, yellowbacks will be a thing of the past. All of the new currency is to be green. Each denomination is to have a distinctive portrait, so its value can be seen at a glance and note raisers cannot make a ten- or a hundred-dollar bill of a one. The face of Washington will be on all dollar bills; the face of Jefferson on all twos; Lincoln on all fives, Hamilton on the tens, Jackson on the twenties, Grant on the fifties, Franklin on the hundreds, McKinley on the five hundreds, Cleveland on the thousands, Madison on the five thousands, and Chase on the ten thousands.

REMAINS of one of the earliest civilizations, recently unearthed by the Field Museum-Oxford University joint expedition in the ruins of Kish, Mesopotamia, believed to have been the first city founded after the Flood. In the top photograph workmen are seen uncovering the ruins of the ancient city. The picture just below it shows the wheels of the oldest vehicle ever found, a chariot dating back to about 3,500 B. C. Near by were skeletons of the animals that drew it. In circle: L. C. Watelin, field director, applying a preservative coat of varnish to the wheels. Right: A copper rein ring found on the front of the chariot.

Back to the Flood

RETURNING from a seven-year archeological expedition in Mesopotamia for the Museum of the University of Pennsylvania and the British Museum, Prof. C. Leonard Woolley reports the discovery of an eight-foot layer of clay which he says was deposited during the inundation of the Euphrates River known in Scriptural accounts as The Deluge.

The discovery constitutes the first historical substantiation of the Biblical story of Noah's flood. What Professor Woolley and his associates found were the effects of an overflowing of the Euphrates over the low-lying land of Mesopotamia. To the dwellers in that ancient country, the flooded region may well have seemed to comprise the whole earth. The eight-foot clay deposit was found overlying older strata not only at one point but in three different places as much as 200 yards apart, indicating a flood of great proportions.

The story of The Deluge contained in the Book of Genesis tells how "all the fountains of the great deep (were) broken up, and the windows of heaven were opened" and it rained for forty days and nights. The waters rose to a height of fifteen cubits, about twenty-one feet, covered the earth, and drowned all creatures except the occupants of the Ark. The Flood receded after one hundred and fifty days, when Noah, his family, beasts, and birds found themselves safe on the mountains of Ararat.

Another account of the Flood is the Sumerian story, contained in written versions that go back to 2,100 B.C. It is virtually the same as that in the Bible, but relates that the disaster arose from a violent quarrel among the gods.

PROFESSOR WOOLLEY conducted his excavation work in the ancient Sumerian ruins at Ur of the Chaldees, the birthplace of Abraham. By unearthing pottery, utensils, and human remains, indicating a race of high culture and commercial development, the archeologists established a Sumerian civilization dating back to 4,000 B.C.

Reaching the bottom of the layer of earth containing evidences of human life, the excavators came upon a stratum of silt or sand about eight feet deep. Beneath this were unmistakable traces of another and older civilization. In this layer were pieces of pottery and other articles of daily use, as well as expertly molded bricks, which, Professor Woolley holds, were used by the people of Noah's time in building homes.

About the same time, the joint expedition of the Field Museum at Chicago and Oxford University, under the direction of Prof. S. Langdon, of Oxford, reported important finds in the ruins of Kish, in Mesopotamia, believed to have been the first city founded after the Flood. Among the discoveries were the remains of the oldest vehicle ever found, the wheels of a chariot dating back to about 3,500 B.C.

Gems Live and Die

A GERMAN mineralogist announces that investigation by X-ray and other methods has convinced him that stones "breathe," live, age, and die!

The scientist found that gems possess characteristics closely resembling those of the human body. They absorb and eject carbonic gas—a function akin to our breathing. Crystals, as well as hard rocks, such as granite, he discovered, will show signs of age in time and finally will break up into sand—which is their way of dying.

The mineralogist's findings constitute the latest addition to the wealth of fact and legend which, through the ages, has grown up about stones, crystals, and gems.

Archeologists have found Babylonian cylinders carved from lapis lazuli engraved with texts showing them to be 6,000 years old! The earliest market for gems was that of Babylon, at about 4,000 B.C. In Eygpt, the two highly prized minerals, malachite and lapis lazuli, were employed as currency, just as were gold and silver.

TODAY the diamond is universally regarded as the peer of gems. Though the pearl, emerald, and ruby are more precious, the diamond is the hardest, most imperishable, and also the most brilliant of minerals. Jewel experts have calculated that less than 47,000,000 carats of cut and polished diamonds exist in the world. These would weigh about ten and a half tons and could be put into a large clothes closet. Their value is approximately $5,000,000,000, and a large share of them is in the United States.

DR. GEORGE F. KUNZ, one of the world's foremost authorities on gems, estimated not long ago that a solid column of diamonds, about three and a half feet square and twelve feet high, would represent the mass of diamond material taken from the mines in South Africa since 1890. And a man can carry a million dollar's worth of diamonds in his vest pocket!

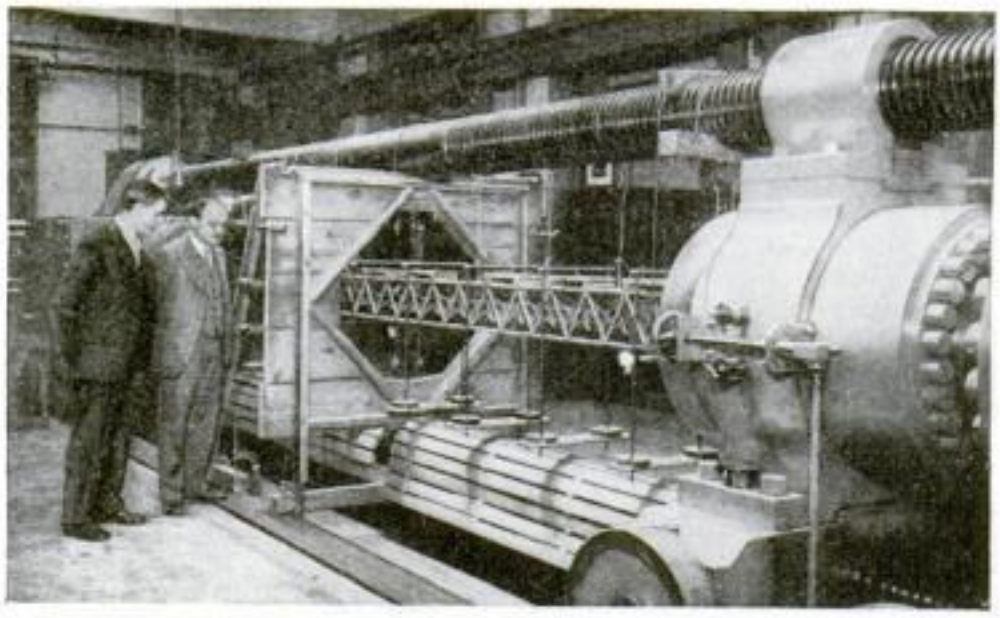
The custom of wearing birthstones, and the origin of the belief in the various virtues inherent in them, have been traced to the breastplate of the high priest mentioned in the twenty-eighth Chapter of Exodus. The stones in this breastplate were set in four rows, with the names of the children of Israel engraved, one on each stone. The stones are believed to have been carnelian, chrysolite, emerald, ruby, lapis lazuli, onyx, sapphire, agate, amethyst, topaz, beryl, and jasper.

The colors of some jewels are greatly affected by radioactivity. This is particularly true of the sapphire. The yellow corundum, or oriental topaz, may have been formed from the blue corundum under the influence of radioactive substances present in the soil in which the sapphire was embedded. Different shades of color may be presented by different stones of the same species.

Airship Ribs Tested

THE U. S. Bureau of Standards recently tested samples of duralumin girders to be used in the two 6,500,000-cubic-foot dirigibles, largest ever built, now under construction for the Navy in Akron, O. In the grip of a huge compression machine in the Bureau's laboratory at Washington, D. C., they showed surprising strength. A girder you can pick up with two fingers will support the weight of six men!

Such girders will give the hulls of new dirigibles strength to outride storms three times as severe as any the present Navy dirigible *Los Angeles* can survive. They will permit the construction of two sky dreadnaughts large enough to carry five scouting planes. These will be lowered through large trapdoors in the bottom of the airship.



A mighty compression machine in the U. S. Bureau of Standards Laboratory, Washington, D. C., tests strength of duralumin girders for the Navy's new dirigibles.

The search for new bones to form the skeletons of air giants at the Zeppelin works, in Germany, led to the discovery of duralumin. While experimenting with various aluminum alloys, between 1903 and 1911, Alfred Wilm, a research chemist connected with the company, stumbled upon it. It contains about ninety-four per cent aluminum, with copper, manganese, and magnesium added.

STEEL framework for airships is strong, but heavy. Wood is light, but weak. Duralumin combines the advantages of both. In strength and lightness, it has proved to be seventeen percent better than alloy steel. Compared with aluminum, its strength is twice as great, while its weight is only one twentieth greater. A child can lift a girder as long as a row of three automobiles!

Airplanes, as well as rigid airship frames, are now constructed of the featherweight metal. It was introduced into the United States in 1919.

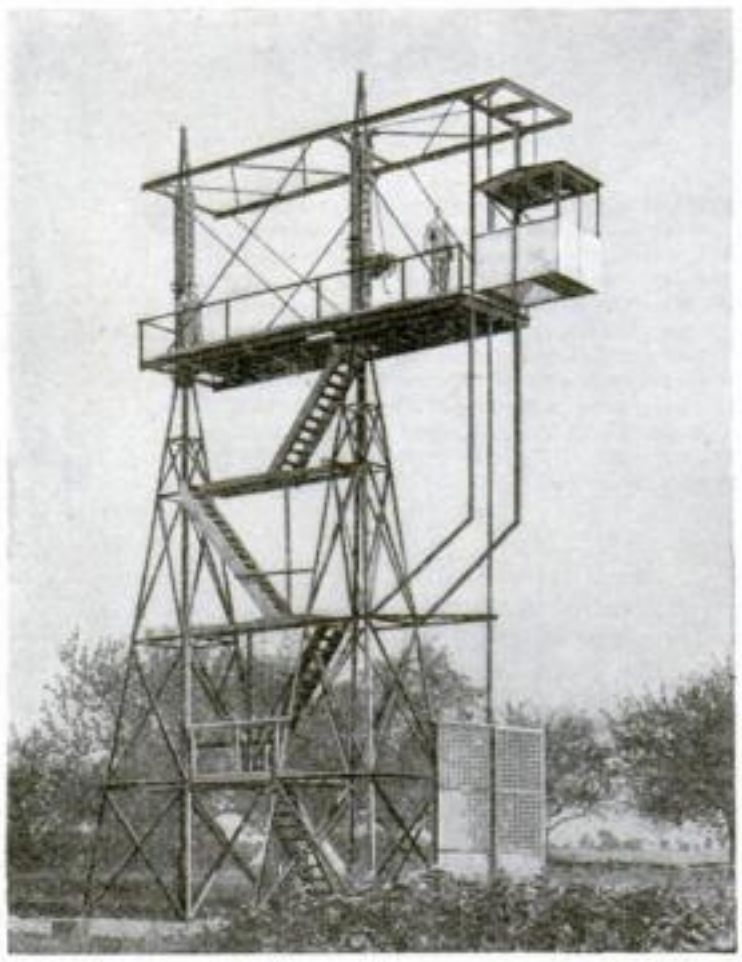
Harness the Sun for Power

HARNESSING the sunlight, dream of inventors, approaches realization in a bandy-legged, fifty-five-foot tower of concrete and steel that Dr. W. J. Harvey, of the Royal College of Science, recently erected a few miles outside the city of Toronto, Canada. It is the latest of a long series of attempts by engineers to capture and harness the 500 horsepower of energy that continually deluges every acre of the earth's surface when the sun is shining.

Could this be done on a commercial scale, experts say, smokeless, sootless, and silent power plants run by the sun would replace our coal-fired power stations. To date, the most promising attempts to harness solar energy have met with indifferent success from a commercial point of view—yet they show that the possibility is based on sound theory.

In Dr. Harvey's new "sun engine," a mirror of 600 panes turns to follow the sun, and reflects upward a white-hot beam of light. At its focus thirty feet above, the temperature is of 3,000 to 6,000 degrees F. An elevator-workshop raised or lowered by a crank, according to the degree of heat required, admits the beam through a trapdoor. To date the harnessed sunlight has done such diverse jobs as charging storage batteries, drying fruits and vegetables, and manufacturing certain chemicals, such as pure oxides.

A few years ago, a highly ambitious project along similar lines was carried out in Egypt. Mirrors covering a half acre of ground were arranged to turn with the sun's movement, and to concentrate its rays on a boiler that supplied vapor to run a steam engine. This plant, operating under the most favorable conditions, developed a paltry fifty horsepower, despite its costly equipment.



Novel "sun engine" near Toronto, Canada. Sunlight reflected from a 600-pane mirror (lower right) charges batteries and dries vegetables in elevator-workshop above.

PERHAPS more practical is the recent plan of Prof. Georges Claude, noted French physicist, to put sunlight to work indirectly. He recently visited Cuba to determine the possibility of installing somewhere on the coast a steam turbine that would be run by the difference in temperature between sun-warmed water at sea level and cold water from the depths. A test installation on the banks of a French river already had shown that such a machine would work.

If it were possible to turn sunlight, say, into electrical energy by making it drive a dynamo, the resulting power could either be used on the spot or transported elsewhere in another form. Thus a serious pro-

John Bellamy Taylor, General Electric engineer, transmitting music over a beam of light.

posal was made before a recent meeting of the Association of German Chemists, in Berlin, that huge sun engines along the river Nile be erected to decompose water electrically into hydrogen gas, and that this "bottled sunshine" be transported to all parts of the world to be burned for light and heat.

Music by Light!

IN THE darkened ballroom of the Hotel Astor, New York City, recently, a beam of light swung toward a small glass target. When it touched the glass, the light burst into music! A man placed his hand before the beam projector. The music stopped. He spread his fingers, and the music swelled. He closed them slightly and it diminished.

In this dramatic fashion, John Bellamy Taylor, a consulting engineer of the General Electric Company, demonstrated before members of the American Institute of Science his apparatus for making sound visible and light audible.

The sending apparatus of his invention transforms the sound produced by a phonograph record into electrical vibrations, and these in turn into light waves. A photo-electric cell in the receiving apparatus catches the light and turns it back into electrical impulses that are transformed again into sound. From the beam projector to the receiver, sound travels on waves of light.

TAYLOR calls his process "narrowcasting" to distinguish it from broadcasting. A somewhat similar invention that transmits sound by means of light has been constructed by Dr. Hans Thirring, a university professor in Vienna, Austria.

At present, "narrowcasting" is only a spectacular laboratory stunt. Its practical value has yet to be demonstrated. One suggested application is in sending secret messages over short distances, as between outposts in time of war. High frequency light waves are not recorded by the most sensitive radio sets. By using infra-red or other rays that cannot be seen by human eyes, beams of "invisible light" might carry messages past the very eyes and ears of enemy observers.

The reason radio waves circle the earth instead of flying straight out into space, experts believe, is because they are repelled by a mysterious "radio roof," the so-called Heaviside layer. That light rays pass through this layer is shown by the fact that the moon shines in reflected light from the earth. Thus it is suggested that if the dream of interplanetary communication is ever realized, light waves will carry the messages.

Our Faces from Fishes

MAN got his face from a fish, according to Dr. William King Gregory, of the American Museum of Natural History, New York City. The other day he exhibited a series of modeled heads demonstrating that every one of man's twenty-eight skull bones has been inherited, in an unbroken succession from fish that lived millions of years ago.

You have probably heard man defined as "the animal that thinks." Another definition might be, "the animal that has control of its face."

Tests with monkeys have shown that they cannot smile. The reason is that they have no muscles to smile with. No other animal has so many facial muscles to alter its expression as man. One fourth of all the muscles in the human body lie in the face and neck. Originally, most of them were under direct control of the automatic nerves. They operated under the promptings of the emotions, independently of the will. Gradually the brain has gained ascendency. Generations of training enable us to smile when we are sad and to act emotions we do not feel.

When you look at the face of a fish, you see a blank mask, unable to express even pain. The fish wears a continual "poker face," with hardly any change of expression. At the highest end of the scale of evolution is the trained human actor who is able to reveal emotion by alterations of his countenance.

Dr. Hans Thirring, of Vienna, Austria, receiving sounds that are transmitted over light waves.

Dr. W. K. Gregory, of American Museum of Natural History, with models illustrating how human face may have evolved from face of fish.

How Much Do You Know About Ships?

TEST your knowledge with these questions, chosen from hundreds asked by our readers. You will find a list of the answers on page 122.

1. **Why do motorships have funnels if they have no need for a funnel to carry off smoke from a furnace under the boiler?**
2. **Why can't you put a ship's propellers at the front and pull it like an airplane?**
3. **What is the advantage of an oil-burning motor over steam engines for ships?**
4. **What is a sonic depth finder and how does it work?**
5. **How is the air in a submarine purified during a long voyage under water?**
6. **What keeps a ship from rolling over in the water?**
7. **What is a sextant and how is it used?**
8. **How can they use steel to build ships when steel won't float?**

The War Against Smoke

A NEW type of automatic camera, operating unaided for eight hours at a stretch, appeared in New York City a couple of weeks ago in the novel rôle of detective in the hunt for an elusive villain considered one of the gravest menaces to the health of city-dwellers—smoke!

Health authorities secreted the new recording device in buildings near offending industrial plants to gather evidence of violations of the city smoke ordinance.

The use of cameras as smoke detectors is the latest development in New York's drastic campaign against the smoke nuisance, which has assumed serious proportions. A few weeks ago, Dr. Harvey N. Davis, president of Stevens Institute of Technology, at Hoboken, N. J., announced that he and fellow-investigators had established the fact that New York City is continually shrouded by a layer of smoke between 1,000 and 2,000 feet thick! This immense smoke screen, the engineers claim, robs New York of about fifty percent of its sunlight.

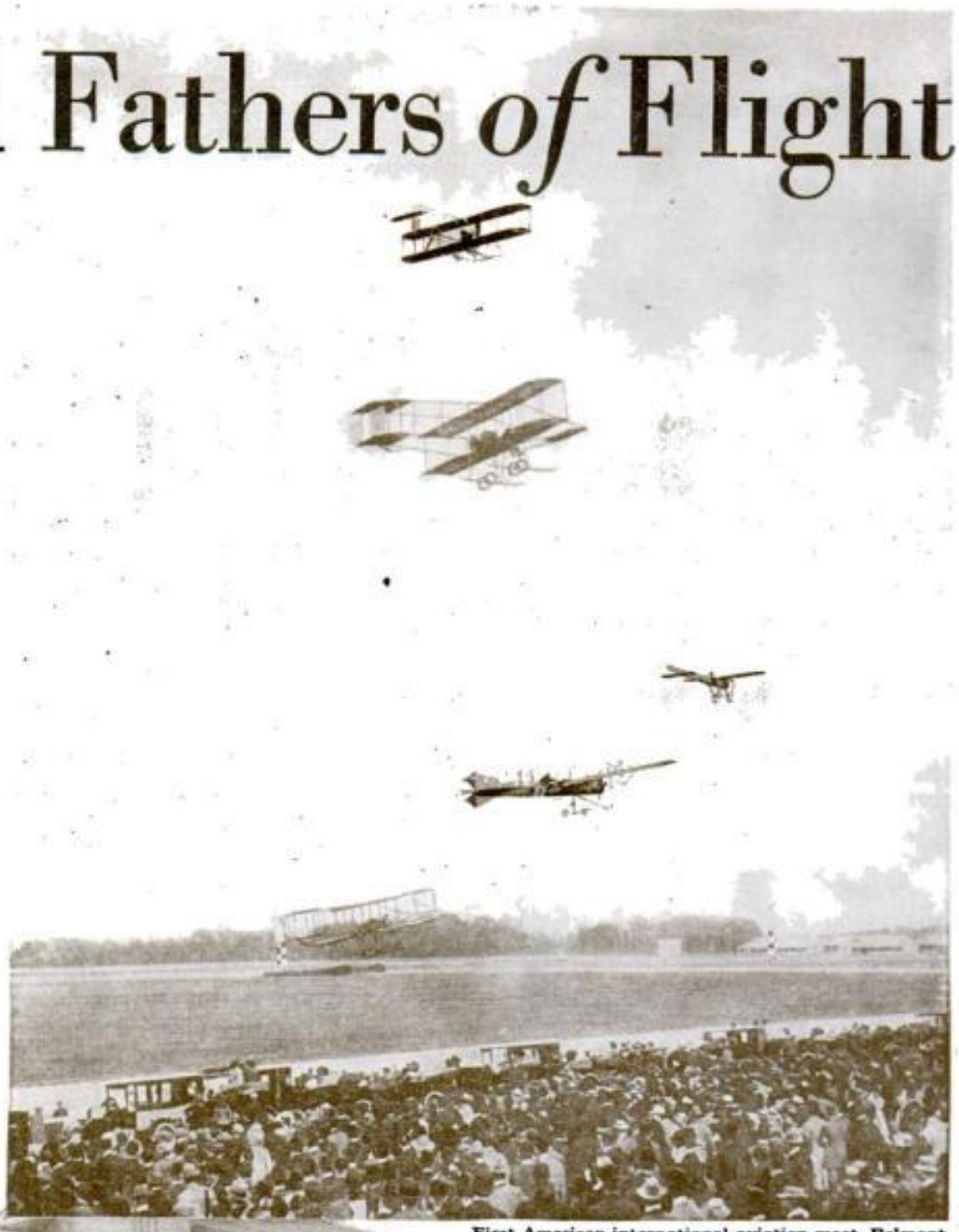
In many other cities, similar campaigns are being waged. One expert has calculated that smoke costs the people of the United States $1,879,000,000 a year, or about $16 for every individual!

The Real Fathers *of* Flight

HOW Wilbur and Orville Wright rode to undying glory in the sky. The final chapter of a great human document, revealing for the first time the inside story of the birth of the airplane.

By

JOHN R. McMAHON

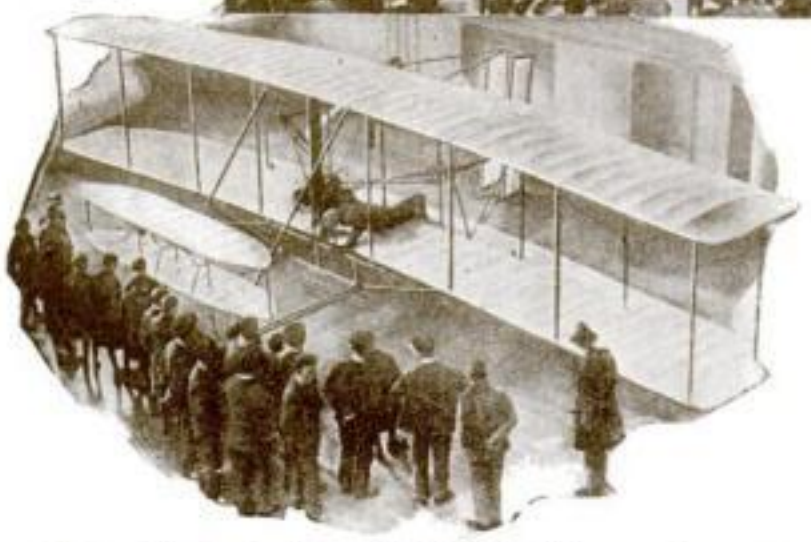


First American international aviation meet, Belmont Park, N. Y., 1910. Wright plane is at top. Below are a Farman, Bleriot, Antoinette, and another Farman.

WHEN the Wright brothers, with their sister Katharine, returned to New York in 1909, after hobnobbing with European royalty, they were greeted as heroes. The Aero Club of America, lukewarm to the inventors two years before, honored them at a luncheon. And in their home city of Dayton, O., there was a great reception. An open carriage decked with flowers and drawn by white horses met the inventors, who, when they had returned from Kitty Hawk six years before, had ridden in an old surrey drawn by a single nag, ignored as eccentric bicycle men who "thought they could fly." The simple dwelling in Hawthorn Street was smothered with flags and paper lanterns for night illumination.

President Taft received the brothers and Katharine at the White House in early June to present a pair of heavy gold medals, showing busts of the inventors, their machine, and the dates of the first hour flights made by Orville at Fort Myer and Wilbur in France. The Aero Club of America had awarded the medals.

Rolling up their sleeves in the old alley shop to build an airplane for Uncle Sam in place of the one wrecked with Orville the year before, the brothers were interrupted by a two-day medal-fest on June 17–18. They received three sets of medals, given by the city of Dayton, by the state of Ohio, and by the Congress of the United States.



First machine to fly. The original Wright biplane as it appears today on exhibition in the Museum of Sciences in London.

On the afternoon of July 30, 1909, at Fort Myer, the younger brother and his passenger, Lieut. (now Brig. Gen.) Benjamin D. Foulois, stepped aboard the newly completed airplane for a cross-country test flight of unprecedented hazard. Foulois had been assigned as the Government observer for the test, which was to determine whether Uncle Sam should buy the plane and establish the nucleus of an Army air service. Wilbur and Katharine, who were present, were afraid. The pilot and his passenger well knew the peril but exercised their courage. Orville was yet lame from the crash on that very spot last year when his companion, Lieut. Selfridge, had been killed.

The brothers had scouted the ten-mile course over hill and dale, rocks and woods, seeking a possible landing place in case of trouble, and had found absolutely none. Nobody up to this time had ever flown over such rough country.

President Taft stood watching the take-off. So did a great crowd on the military field, buzzing with excitement, whispering about the previous accident. "It's murder!" some declared. "This time both will get killed". . . . "Well, what can you expect of the military gang?"

Orville and his passenger were not laughing this time—perhaps that was a good omen. The plane became a dot over hills and ravines, then faded out of sight in the distance.

WILBUR stood like a statue, field glasses to his eyes, a watch in hand. His agitated sister was beside him, biting her lips. He had closely figured the time in which the plane should reappear. All over the country newspaper bulletins, scanned by awed multitudes, tolled off the minutes—"He's off! . . . . One — Two — Three . . . . Out of sight . . . . He should be reported now . . . . He is due . . . He is overdue! . . . "

The lean hawk-face of Wilbur did not move a muscle to indicate his state of mind. But his forehead became beaded with sweat that rolled down his lined cheeks.

Charley Taylor, trusty mechanic of the Wrights, could not stand the strain as the overdue minutes accumulated, and wailed:

Belated honors. Orville Wright (center) receiving the Distinguished Flying Cross from former Secretary of War Davis last February. America's highest award was also presented posthumously to Wilbur.

"He's down! He's down!"

Katharine turned on him with a sharp reprimand. Wilbur silently sweated, his eyes fixed on the empty horizon. A cousin of the Wrights, Professor David W. Dennis, stood beside them.

At last Professor Dennis yelled:

"There he is! There he is!"

Wilbur's face relaxed in a great content and Katharine's heart leaped with joy. A mighty cheer and tumult of motor horns arose from the parade grounds as Orville and his companion came gliding home, and the acclaim was shortly echoed by crowds in distant cities. The delay had been due to wind and a strayed balloon marker. But the plane made a record for passenger transport, fourteen minutes at forty-two miles an hour, and earned a bonus of $5,000 for its speed. President Taft congratulated the brothers on the spot.

SOON afterward Orville sailed for Germany with his sister to convince the hardheaded "Fritzies" that the air was navigable without aid of gas—a point their high officials had refused to concede. Wilbur stayed on this side to fly at the Hudson-Fulton celebration.

New York had its first sight of the airplane on Sept. 29, 1909, when Wilbur rose from Governor's Island, circled it to the shrill salute of all harbor craft, landed, and then rose again for a pioneer turn around the head of the Statue of Liberty. Sirens screeched, handkerchiefs fluttered, crowds cheered.

These were the first flights over American water. Bleriot had crossed the English Channel two months before, which fostered the belief in some quarters that the French collaborated in the invention of the airplane. Bleriot himself accorded pioneer honors to the men of Dayton.

The metropolis enjoyed its greatest treat on Oct. 4 when Wilbur traced in the air part of the voyage made up a great river by Henry Hudson in the *Half Moon* three centuries before.

A MILLION or so spectators lined the shores and gasped at the sky craft skimming over ten miles of gray water and gray battleships assembled from the navies of the world. The route was to Grant's Tomb and back, some twenty miles done in about half an hour. A canoe was lashed under the machine. The inventors never used skis on their plane nor built an amphibian.

Meanwhile Orville and Katharine, arriving in Berlin on August 19, were received as personages of the first rank. Two years before German officialdom had stubbornly combated the existence of the airplane. Now the skeptics loudly hailed Orville as a new kind of a "kolossal" magician. He was a superman. The populace played a game of reverential tag with his person, crowding around to touch the back of his coat or mayhap the edge of his sleeve. A handshake was enough to make an idolator faint.

When President Taft presented medals to the Wrights at the White House in 1909. Wilbur stands at the President's right; Orville and Katharine at his left. This photograph bears the inscription: "For Miss Katharine Wright with the best wishes of Wm. H. Taft."

At the first flight at Tempelhofer Field the crowd almost killed the inventor and his sister, so that afterward they were protected by a hollow square of Uhlans. As their car proceeded through Berlin streets it was followed by a phalanx of young bicyclists who chanted: "Orvele Wright! Orvele Wright!" A quarter of a million throats bellowed "hoch's" at the military field.

A jaunty young man stepped from his car at the field. Shaking hands with Orville, he lifted his hat to Katharine with the words, "Is this your sister?"

The Crown Prince forthwith shook hands with Katharine, and then had the Americans meet Crown Princess Cecilie.

The Kaiser's son quivered with excitement as the airplane roared, shot down its launching track, rose in the air, climbed, and circled overhead. As the machine landed he gave vent to his impetuous emotions in terms like these:

"Wonderful! Magnificent! I'm just crazy about it. I'd like to fly with you, Mr. Wright. Will you take me up? Yes, right now!"

Orville did not care to take chances with such a passenger, especially on account of possible objections by his imperial papa, and having practiced the denial of royal pleas on the King of Spain, knew how to smile away the crown-princely yearning.

THE Emperor sent word he wished to meet the Americans at Tegel Field on Sunday, August 29. Count Zeppelin was to be on the scene in his newest dirigible. A long-winded court preacher kept Wilhelm so long in church that all hands at the field, including the gas-bag contingent hovering above, had to wait for hours. At last a string of tooting cars appeared. Officials became ramrods, goose-stepping soldiers cleared their throats to cheer. The War Lord greeted Orville in a friendly manner and conversed with him in fluent English. Katharine, tired of waiting, had wandered off and coolly disregarded the entreaty of a panting general to return and meet the All-Highest. What a woman! She never even asked Orv what he and Wilhelm said to each other on this occasion. I guess by this time she had a surfeit of monarchs. This was the fourth, not to mention a President.

Orville had a ride in the Zeppelin from Frankfort to Mannheim.

At this time the Wright brothers were giving their greatest international show in simul-

(Continued on page 154)

How the neighbors decorated the Wright home in Dayton, celebrating their return from European triumphs in 1909.

Novel Silo Built of Wire Fence and Roofing

WIRE hog fence and roofing paper were the only materials used in a novel silo built on the farm of Fred McLeod, McLouth, Kan. Successive circular "stories" of woven wire fence were clipped securely together with triangular loops of metal which are ordinarily used to "ring" the noses of hogs to prevent them from rooting.

As each circle of fence was finished, it was lined with heavy roofing paper and filled with ensilage before the next "story" was added. Five or six rings of the fence wire were found to reach about the limit of height for the unbraced silo, which is designed to provide an inexpensive storing place on farms where ensilage is fed in large quantities soon after it has been packed away.

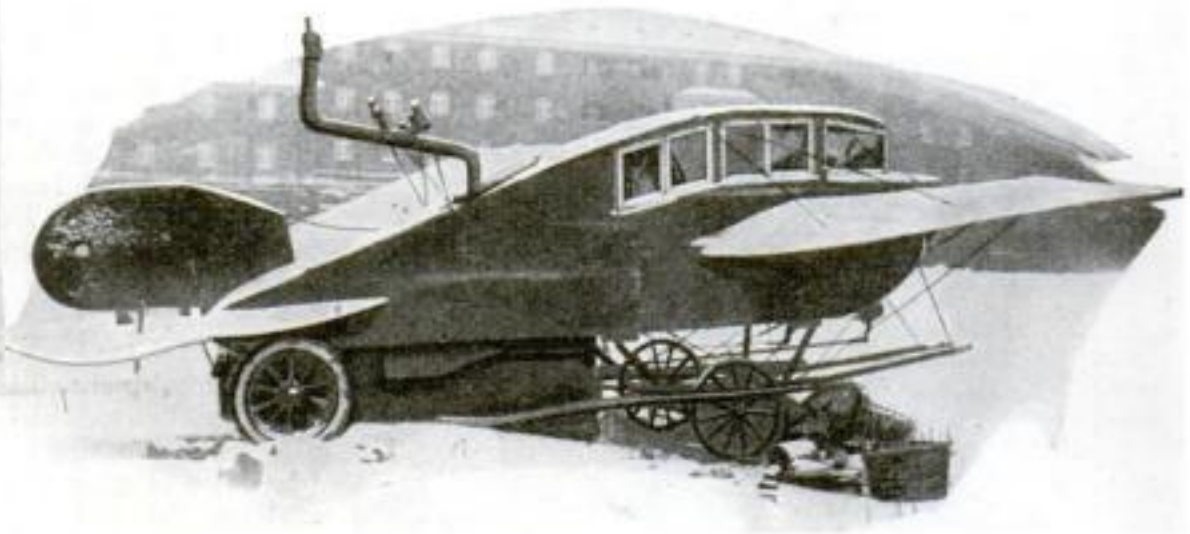
1929 Icarus Tries Wings and Hits the Dust

THE legend of Icarus, up-to-date, is to be seen in the recent brief but thrilling experience of a West Orange, N. J., lad. David Clark, aged eleven, fashioned a pair of wings in his father's cellar. In the absence of his parents, he climbed upon the sill of a second-story window, unfurled the newly-created pinions, and launched himself upon the breeze.

Like the legendary Icarus who fell to earth when the sun's heat melted his artificial wings, David's attempt was not a success. The shades of Simon the Magician, who essayed a flight in A.D. 66 and broke his neck—of Jean Baptiste Dante, fifteenth-century mathematician, who fell upon a church in his first attempted public flight—and of the unnamed Italian friar who crashed to earth with a broken thigh-bone while attempting to demonstrate the art of flying to King James of England—may well have looked on and smiled in sympathy as David Clark, of West Orange, hit the ground after his short but exciting flight of about ten feet, mostly vertical and in an earthward direction.

At least, he was not seriously hurt; they took a few stitches in his head, plastered and bandaged his scratches, and pronounced him fit. What is more, David has no scoffing populace of former days to greet—he has but to point at a mail plane passing overhead and say "It can be done!"

He Keeps House in a Discarded Monoplane



The winged bungalow, latest in dwellings. The plane's cabin makes a cozy living room. From the kitchen in the rear rises a chimney. The house can be moved any time.

"WHERE do you live?"

"The fourth airplane from the corner."

Such conversations may actually occur if many people follow the fashion set by a Berlin, Germany, man who uses a discarded monoplane for a dwelling place. The forward part of the fuselage, with windows commanding a view in three directions, is utilized as a living and sleeping room. The rear forms the kitchen. Above it rises a chimney that describes a letter "S" near the rudder. The site of the unique airplane house is a vacant lot, where the machine is allowed to stand free. In case the house has to be moved, the owner points out, he can hitch a horse or an automobile to it and haul it to a new site like a gypsy wagon.

Electric Voting Machine to Speed Elections

ELECTRICITY will do our voting if a new machine recently demonstrated before the Board of Elections in New York City is adopted throughout the nation. It was invented by Samuel R. Shoup and his son, Ransom F. Shoup, who report that the complete machine can be set up in a voting booth in fifteen minutes and is ready for operation as soon as it is plugged into a wall socket.

The voter, using the invention, first presses a button, then turns down a handle opposite the name of each candidate of his choice, and a "yes" or "no" handle beside each proposition to be voted on. Then he presses the button a second time and electricity records his entire vote. The whole operation is said to take from seven to eight seconds.

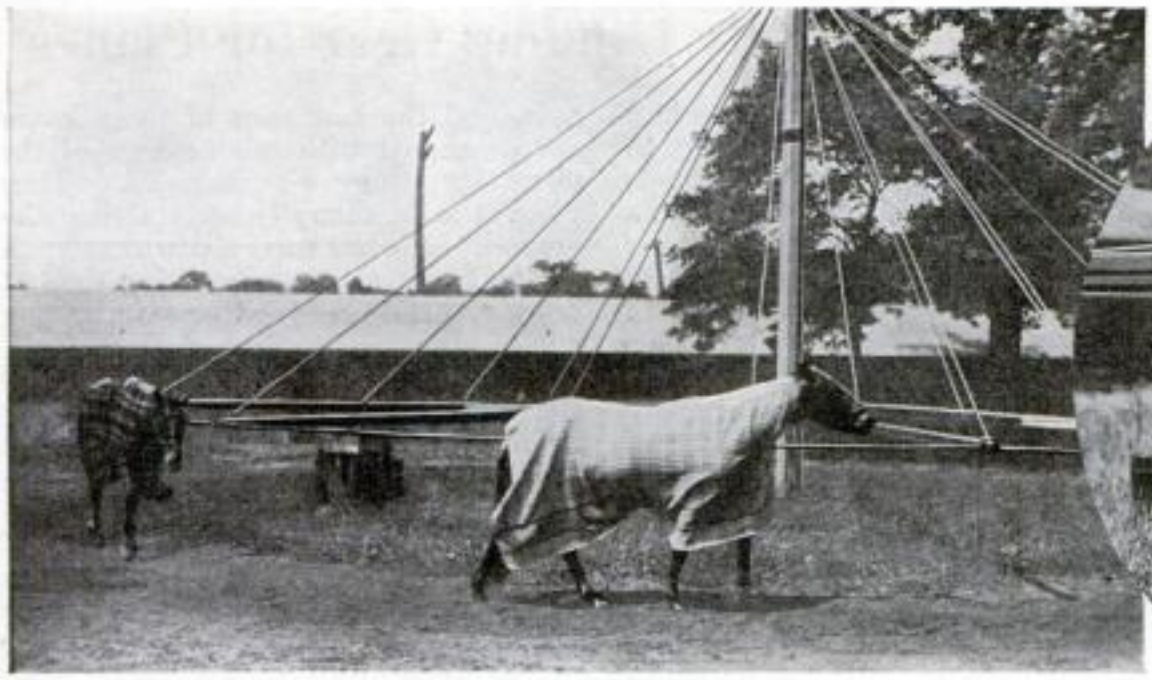
John R. Voorhis, president of the New York City Board of Elections, operating electric voting machine.

Women Inventors Busy on Household Improvements

AN INQUIRING young feminist recently ferreted out the information that, in the year 1914, patents were granted to women inventors for an automatic lubricator, a system of electrical distribution, a wheeled baggage carrier, a control for an electrical engine starter, a parachute for airplanes, a new type of rivet, and a submarine! She also discovered that, between 1790 and 1910, American women had obtained patents on close to 11,000 devices, and that the number of patents taken out by women was greatly on the increase.

Inquiring further, the investigator found that women inventors, of late, have been concentrating on labor- and timesaving devices for the home and that patents have been granted to them for a large variety of cooking utensils, bathroom fixtures, nursery furniture, sewing machine accessories, folding tables, and mechanical toys.

Here, apparently, is proof for the more conservative that women, for a while at least, does not intend to foresake dusting and dishwashing altogether, but has merely made up her mind to take the drudgery out of these chores.



The inventor of the merry-go-round horse "leader," B. E. Rickabaugh, with the motor that drives it.

Mechanical Leader "Cools Out" Race Horses

A MERRY-GO-ROUND for training race horses has been invented by B. E. Rickabaugh, a trainer of Wooster, Ohio. The animals are tied to the rim of a huge revolving wheel, after a workout, and walked around until they have "cooled out."

The "leader," as Rickabaugh calls his invention, will accommodate eight horses at a time, thus releasing for other duties that number of "swipes," or rubdown men, who usually walk the horses after a workout. The wheel of the merry-go-round is fifty-two feet in diameter and has a heavy wire rim. The eight spokes of the wheel are of two-by-four lumber. A metal collar forms the hub, encircling a section of telephone pole used for the axle of the merry-go-round. At the top of this pole, a smaller wheel supports guy wires that keep the large revolving wheel in a horizontal position and about four feet above the ground.

The horses are tethered to the ends of the spokes and led at a uniform speed, a small gasoline motor turning the wheel at a pace governed by the trainer.

Our Roving Eyes Move 100 Times a Minute

THE human eye roves to and fro with an involuntary rhythm of its own, like the heart, according to a distinguished Russian scientist, Serge Yourievitch, whose researches have just been presented to the Academy of Sciences in Paris. This rhythm, he says, averages about 100 movements to the minute.

He found that the human eye is never still longer than a moment or two at the time. In a familiar, quiet room, where nothing moves, the normal person's eyes remain at rest for a second or two, after which they begin their customary movements, sometimes up and down, then again from one side to the other. Evolutionists assume that these involuntary roving motions of the eye are an inheritance from modern man's early ancestors, who lived in circumstances requiring constant watchfulness.

Handle of Cane Carries Cigarette Lighter

NEITHER matches nor pocket cigarette lighter are needed by the smoker who carries a new cane recently exhibited in London, England. When he desires a light, he unscrews the top of his walking stick. In the handle a gasoline lighter is secreted. A whirl of the sparking wheel and the torch flares up. After the cigar or cigarette is lighted, the flame is blown out and the top screwed back on the cane. The lighter is removable.

Happy Hunting Grounds for Germs Is Unhappiness

THE fact that there is an important connection between mental contentment and physical well-being is generally accepted, but according to advices from Germany, it was left for two scientists there to demonstrate by actual experiment that unpleasant emotions reduce the bodily resistance to disease germs.

The physicians studied the cases of three women who were susceptible to the lip-eruption known as "cold sore," caused by germs living in the nose or throat, and discovered that these sores invariably appeared after an emotional disturbance. To prove their theory, they subjected the patients to hypnotic treatment while no sores were in evidence and, under hypnotism, suggested unpleasant experiences to them. New sores developed immediately, to disappear again when a happy state of mind was regained.

When he wants a light, he unscrews the top of his cane. A sparking wheel lights the torch.

Did Plants Migrate Like Birds Ages Ago?

THE mysteries of bird migration have occupied scientists for many years, but the startling theory that American flowers migrated by water routes to the South Sea Islands millions of years ago was advanced for the first time recently by a Honolulu botanist.

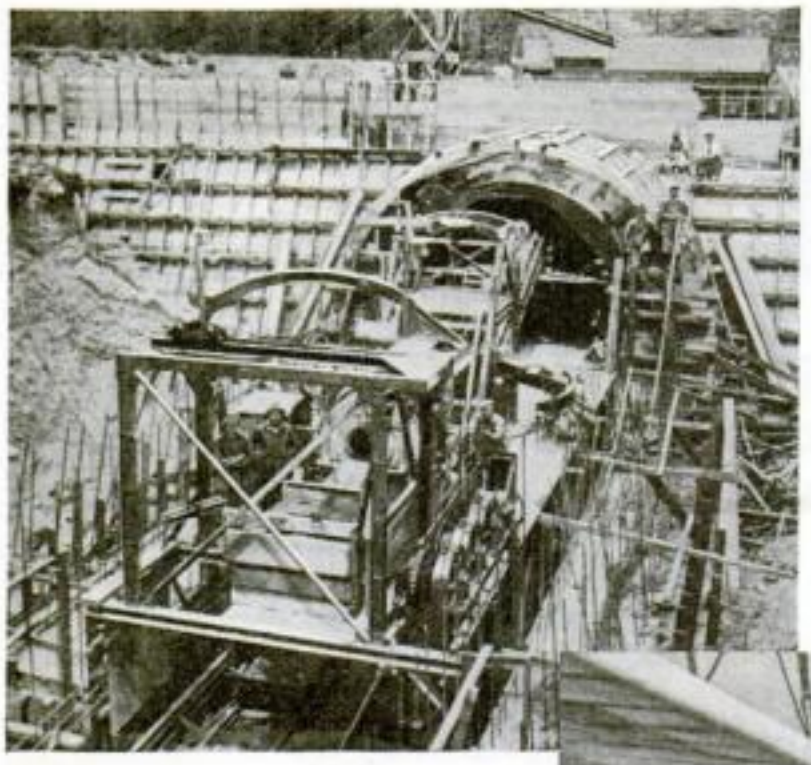
On the island of Rapa, the Hawaiian scientist found a plant called lautea, a primitive relative of the American dogwood and the only member of that family ever found in the South Pacific Islands. He accounted for its presence there by explaining that seeds of this plant drifted down the Mississippi, across the Gulf, through the strait which, in that early era, separated North and South America, and so on southward.

The theory is substantiated by the fact that fossils found not long ago in New Jersey showed that identical lautealike flowers grew there some forty million years ago. In the intervening eons, however, the American dogwood has evolved into more elaborate forms.

How Much Is a Billion? It Depends on Where You Are

IN A race to count a billion, Americans would always beat Germans and Frenchmen would defeat Englishmen. Why? The answer is easy. It has nothing to do with the ability of the contestants. It is merely because in Germany and England a billion means a million million, and in France and the United States it means only a thousand million.

At a recent World Power Conference, held in London, papers were read by scientists from many countries. They spoke in terms of billions that meant different values. Delegates were confused, and misunderstandings arose. A question that must be settled in the near future is: How much is a billion?



Walls of Cascade Tunnel Laid in Record Time

BY THE use of ingenious concreting machines, the enormous task of lining the eight miles of the new Great Northern Railway tunnel through the Cascade Mountains, in Washington, with concrete walls two feet thick was accomplished in the record time of twenty days. One of the machines is pictured above.

The concrete was mixed and poured into forms by machines mounted on a platform which moved through the tunnel on rails of extremely wide gage. Meanwhile, as it progressed, cars loaded with rock from excavation operations further in the passage ran out "between its legs" on narrow gage tracks. This made it possible to begin the concrete work before the entire bore was cleared, and thus greatly hastened the completion and opening of the tunnel.

This tunnel, the longest on the western hemisphere, penetrates through the granite of a mountain peak 3,000 feet below its top. It eliminates forty-six curves and six complete circles in a distance of seventy-two miles. The longest tunnel in the world is the Simplon in Switzerland, twelve miles in length. The Simplon is a double-bore tunnel; the second bore was completed in 1921.

The Moffat Tunnel in Colorado, between six and seven miles in length, is the second longest bore in America.

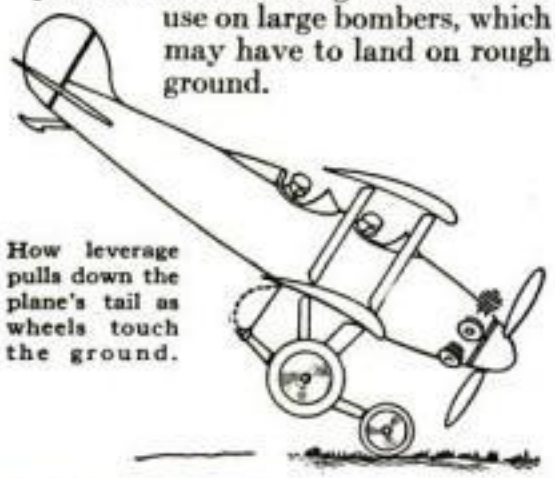
New Safety Landing Gear for Planes

CRASHES by student pilots who attempt to land at too steep an angle are said to be reduced to a minimum by a landing gear designed by a French aviation expert, J. Fritsch, of Paris. When the plane approaches the ground at a steep angle, small auxiliary wheels mounted in front of the main landing wheels strike the ground first. These small wheels are attached to arms or levers pivoted at the center of the landing gear, and the rear ends of these levers are connected with the fuselage of the plane by strong elastic ropes. Thus when the auxiliary wheels strike the ground, the levers exert a downward pull on the fuselage that helps bring the tail down and the machine to a safe landing angle. As soon as this angle is reached, the pull on the fuselage is released and the machine rolls along on its regular landing wheels.

The greatest value of the new gear, the inventor says, is to prevent nosing over when student pilots make awkward landings. But it is also expected to prove a safeguard for experienced airmen in making night landings or in coming to ground with a tail wind.

The Fritsch invention is said to have been adopted by the French army for testing new types of planes. It is also being considered for use on large bombers, which may have to land on rough ground.

The new safety landing gear on a French training plane. The auxiliary wheels keep the plane from nosing over.



How leverage pulls down the plane's tail as wheels touch the ground.

ALMOST every great invention, like the telephone or steam engine, was inspired by previous ideas and discoveries. The scores of new ideas on these pages each month are not only fascinating in themselves, but stimulating to men of creative ability.

Collapsing Bridge Buries Crowded Motor Bus

WRITHING girders of steel crashed down upon a loaded motor bus near Warnersville, N. Y., recently when a bridge over a small stream gave way as the machine was crossing. The heavy motor coach had reached the middle of the span when the bridge caved in. It demolished the machine and injured eleven of the passengers, two dangerously.

The tangled debris of the bridge was as thoroughly twisted as though struck by a cyclone and had to be removed before the wrecked bus could be recovered.

After the bridge crashed—a large motor bus enveloped in a tangle of twisted steel in the collapse of a span at Warnersville, N. Y. The bus was loaded with passengers. Eleven were injured, two badly.

Weather Mast for Air Line

ANOTHER step in providing facilities for world-wide airship lines is the erection of a 200-foot mast at Karachi, India. It will afford meteorologists an opportunity to study the gustiness, temperature, and general weather conditions at the height at which the dirigibles will "dock" when coupling to the mooring mast at the end of trips in the proposed service between Egypt and India which Great Britain plans to inaugurate in 1931.

Scientist Links Early Man to the Garden of Eden

MAN, in his present form, appeared about 1,000,000 years ago, probably in caves in Iraq, in Mesopotamia, which is not very far out of line with the traditional location of the Biblical Garden of Eden, Dr. George Grant McCurdy, of Yale, recently declared. He based his statement on discoveries made in excavations outside of Bagdad.

An earlier type of man than any now existing lived in a uniformly mild climate 1,250,000 years ago, while three "ice ages," in which a large part of the earth was covered by glaciers, were survived by humanity, according to Dr. W. H. Hobbs, of the University of Michigan. The fourth glacial period, now about half over, drove men into caves and made them nomads.

Glaciers began to recede from Scandinavia about 12,000 years ago, Dr. Ernest Antevs, a Swedish geologist, believes, and man then began to develop into the types of today. The polar ice caps may be completely melted in another 12,000 years and mankind return to the age of perpetual spring.

Water Heated Electrically While You Sleep

YOU will have a plentiful supply of hot water in the morning for bath and breakfast, heated electrically during the night, if a new system worked out recently by a British electrical engineer is adopted in this country.

The proponent of the new water-heating method pointed out that much less current is used at night than in the daytime, and that electricity, therefore, should be cheap during the hours spent in bed by the majority of people. This would permit the electric companies to quote low rates on night current, which could heat water for household uses.

The hot water, he said, could be stored in special tanks covered with a heat-insulating material to keep up the temperature during the day while the electrical current was used for other purposes.

Huge "Whales" of Lumber Make 1,200-Mile Trip

ENOUGH lumber to build a town recently floated down the Pacific Coast from Washington to San Diego, California, in three giant, whale-shaped rafts. Each of the rafts contained approximately five million feet of lumber. Heavy steel chains, wound around the logs, held them in place during the 1,200-mile journey, which was accomplished without accident. On the back of each lumber "whale" additional logs were corded and bound with chains.

Near the ends of the rafts, upright spars, in the form of letter A's, held lanterns that marked the position of the floating timbers at night and prevented collisions with coastwise vessels.

Pile Driver Advances Over Footing It Builds

A PILE driver that drives piles ahead of itself and follows the work over the tops of the piling has been built by Army engineers for use in making dikes to catch the silt and build up low places along the banks of the Missouri River near Kansas City.

Such piles formerly were driven by pile drivers mounted on barges, and work could only be done when the water was deep enough to float the barges. The new driver can be used regardless of low water. It also enables operations to continue in winter, even should the river be frozen. The machine can be dismantled in four hours and reassembled in eight.

Composer's Portable Piano No Larger Than Trunk

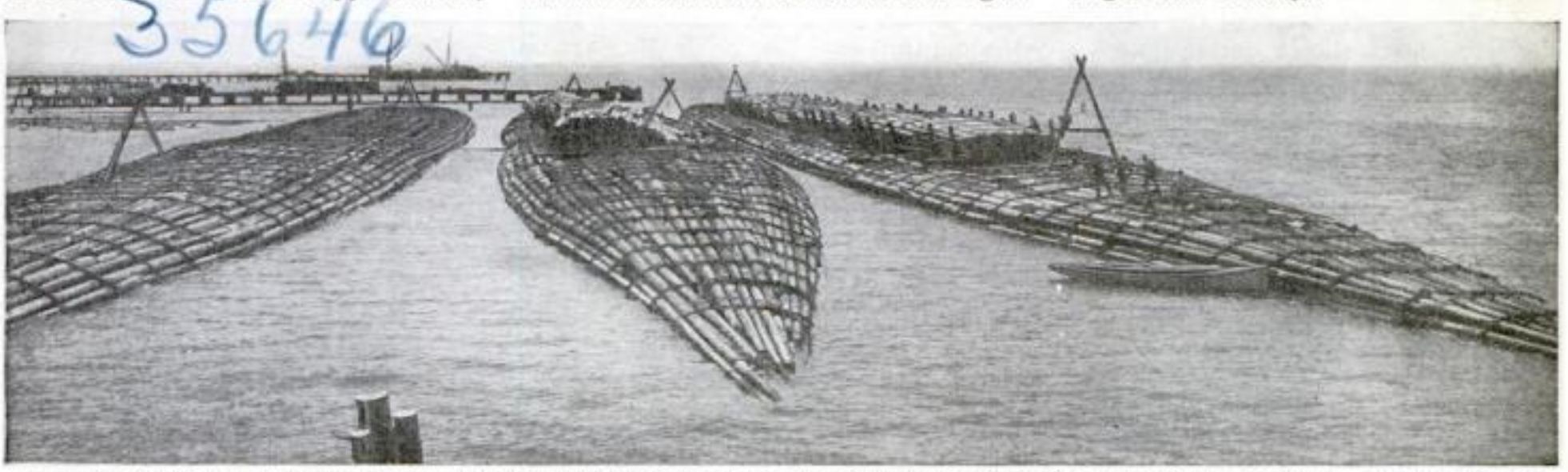
A FOLDING piano that can be carried in a case no larger than a steamer trunk was recently designed for Rudolph Friml, famous musical comedy composer, for use on a world tour. The knee-high piano provides him with an instrument if he has an inspiration when a full-sized piano is inaccessible. All that is necessary to prepare the instrument for playing is to fold down the keyboard.

Such miniature pianos are expected to play the same role for traveling composers that the portable typewriter plays in the lives of globe-trotting writers.

You Can't Escape a Cold, Medical Experts Say

MELANCHOLY news for perennial coughers and sneezers emanated recently from the Johns Hopkins University Medical School, in Baltimore, Md., where specialists in nose, throat, bronchial, and pulmonary diseases, after six months of study and practical experiment, concluded that there is no immunity from the common cold.

Observations were made of 181 students. Outstanding among the physicians' findings was the fact that there appears to be no connection between defects of the nose and throat and the frequency with which a person catches cold. On the other hand, it was found that those who have obstructed nose passages keep their colds longer. Among the students were eighty-seven who had good breathing space, and of these only thirteen had colds persisting longer than ten days. Of twenty-three who had poor breathing space, ten suffered colds which lasted longer than ten days.

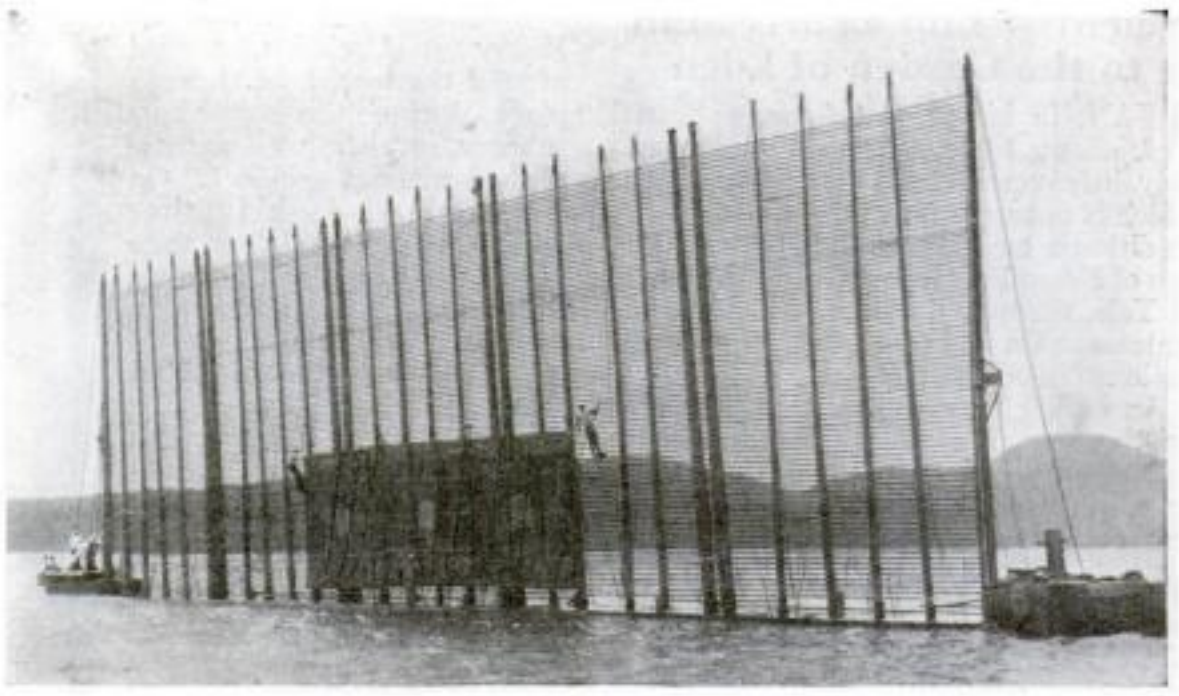


Each of these three whale-shaped rafts of logs contains 5,000,000 feet of lumber, enough building material for the construction of a town. They were floated 1,200 miles down the Pacific Coast from the state of Washington to San Diego, Calif. Warning lanterns can be seen suspended from A-shaped supports.

"Ghost Warship" Rigged as Target for Big Guns

GROOMING a phantom battleship is part of the work of the men who participate in target practice with the American fleet. The "battleship" consists of targets of cloth representing vulnerable sections of an imaginary dreadnaught. The cloth is supported above the sea by a long row of masts rising from a low-floating raft. Crosspieces of wood, like the lathing of a wall, connect the masts and enable the sailors to climb up to adjust the fabric targets and "bull's-eyes" at the proper height above the surface of the water.

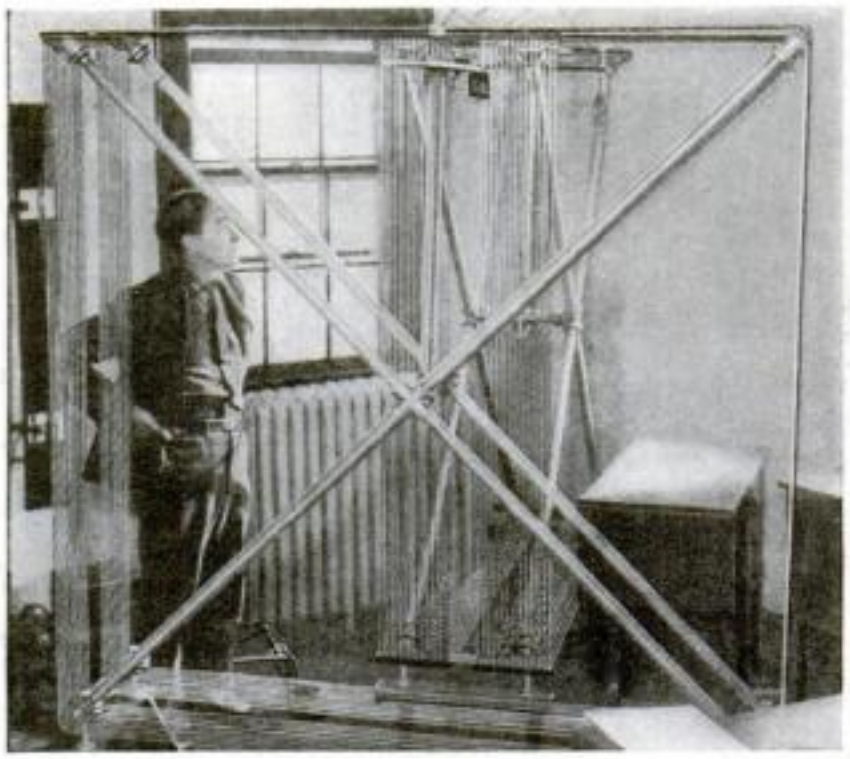
After a fusillade has been fired from the big guns of the dreadnaught, the target is examined and the number of times the phantom ship has been "sunk" is determined.



One of the floating battleship targets in a bay near Manila, P. I. Members of the crew of the U. S. S. *Pittsburgh* are seen preparing the fabric "bull's-eyes" for night practice with the ship's big guns.

Static Serves as Weather Prophet for Flyers

STATIC, the bane of radio fans, is being put on the credit side of the ledger by the U. S. Navy Bureau of Aeronautics. The crashes of interference that often ruin broadcast reception are used by weather observers to locate the direction of storms and so aid flyers on the airway between Anacostia, D. C., and Lakehurst, N. J., the home of Navy lighter-than-air craft.



Six-foot loop aerials used by weather experts of U. S. Bureau of Aeronautics to determine the direction of static as an aid to flyers.

A pair of six-foot loop aerials, at right angles to each other, record the static in the Navy observation room, in Washington, D. C. When a loop aerial is edgewise to the source of static the volume is greatest. So the aerials are swung about until the direction of maximum static is determined. From that direction storms may by expected, as static is thought to be caused by electrical disturbances closely related to the approach of storms.

Frog Barks Like a Dog—and It Bites, Too!

A HORNED Brazilian frog which barks like a dog when it loses its temper, is one of the latest arrivals at the reptile house of the New York Zoological Park, where officials pronounced it one of the most unusual amphibians in existence.

The strange frog is five and a half inches long and green-bronze in color. The keepers were warned that the animal was dangerous, but they were inclined to disregard this on account of its small size until they saw it aroused. Apparently averse to publicity, the frog made as if to attack a photographer who had come to take its picture shortly after its arrival. It jumped at the man, snapped its jaws, and barked furiously, in much the same manner as does a dog when it is angry.

One of the curators, after examining the frog, said that it could inflict a painful wound with its strong jaws and teeth.

Radio Speeds Ship Repair

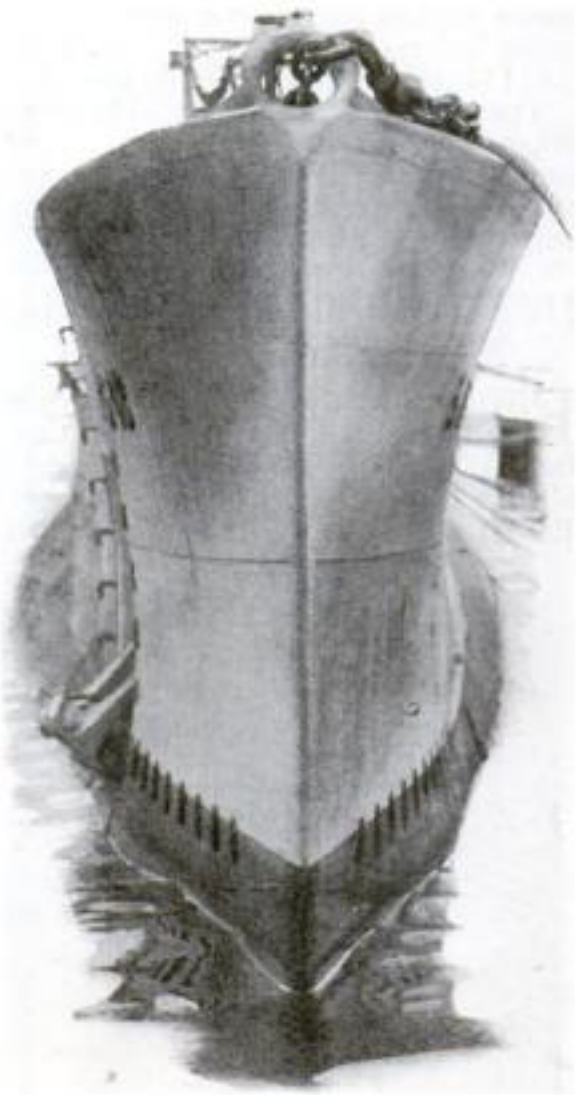
SKETCHES of the rudder and rudderstock of a disabled ship, sent by photo radio from London to New York, recently saved thousands of dollars for a steamship company and proved a substantial aid in the quick repair and restoration to service of the damaged vessel.

Having lost rudder and rudderstock in a storm on the Atlantic about 700 miles from New York and 500 miles from Boston, the cargo liner *Silver Maple* radioed to the branch office of her company in New York for assistance. Two United States revenue cutters were sent to aid her. Meanwhile the New York office started preparations to have her rudder repaired. Since there were no plans of the ship in New York, a radio message was sent to the main office of the steamship company in London asking that sketches be sent as soon as possible.

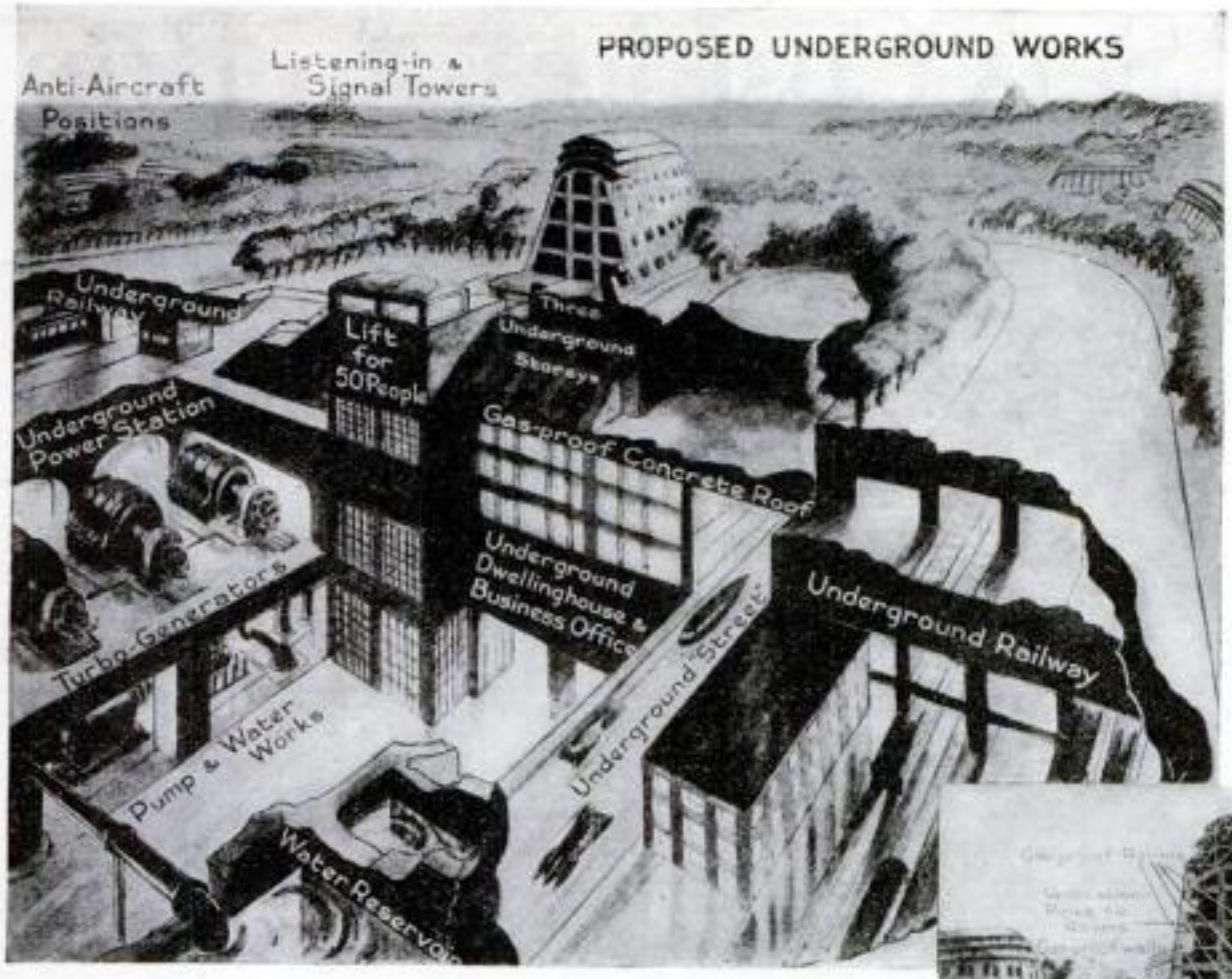
In a few hours, sketches of rudder and rudderstock arrived by radio at the New York office. The next day, less than forty-eight hours after the *Silver Maple's* call for help had been received, the plans were on their way to a shipyard at Chester, Pa., and the new rudder and rudderstock were ready by the time the damaged ship entered a Bermuda harbor a few days later.

Luckiest Submarine, *S-48*, Survives Two Mishaps

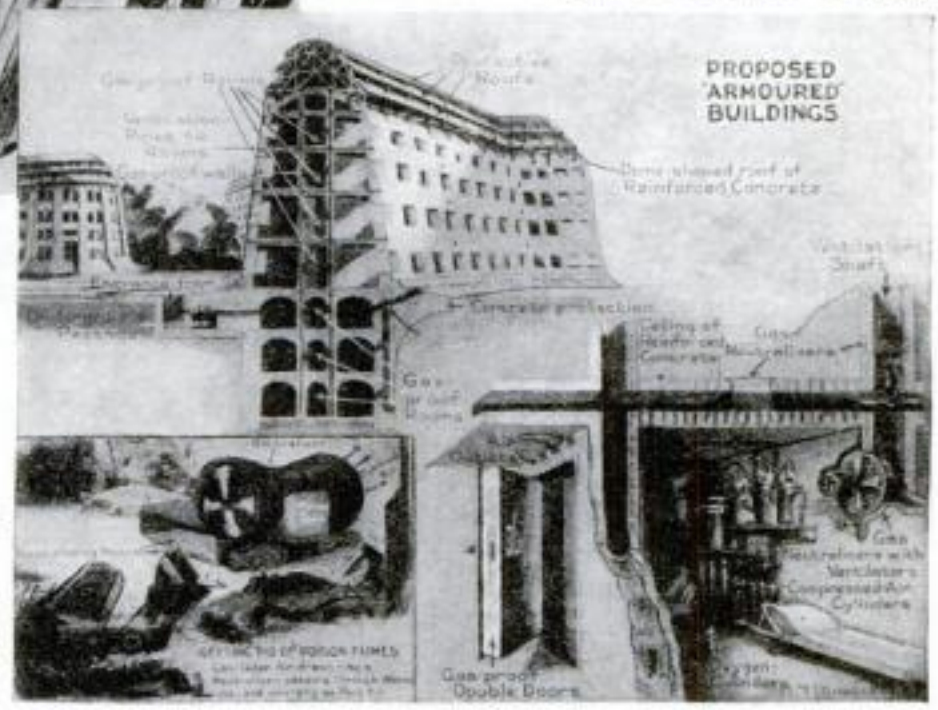
BORN under a lucky star, the submarine *S-48* of the U. S. Navy is still in service after two serious mishaps and eight years of activity. Soon after it was built in 1921, it sank off the Connecticut coast during a trial. All of the crew of fifty-one were saved. Four years later, in a January blizzard, the submarine went on the rocks off Portsmouth, N. H. The crew of thirty-nine were saved. Later it was floated to the Portsmouth Navy Yard and pulled up the ways by three locomotives hitched together, the first time that such a feat was accomplished.



Still going strong after eight years—U. S. submarine *S-48* in Charleston Navy Yard.



Above: Russian plan for underground city construction to protect against air attacks, showing subterranean offices, homes, railways, and public utility works; also gas-proof roofs.



Right: Proposed design for bomb-proof buildings with gas-proof walls and rooms. Inserts show methods of filtering poison gas from air supplied to sealed rooms in an attack.

Armored Buildings, Subway Cities, for Air Defense

BUILDINGS with "armored" walls and gas-proof chambers are suggested to protect citizens from air attacks in future wars. The Soviet government is reported to be considering the erection of experimental buildings of this type in Russia. Walls and foundations would be of thick reinforced concrete. Each floor would contain a gas-proof room with air-tight double doors and a supply of oxygen tanks ready for an emergency. Below the structure, underground storeys would form additional safety refuges, and above, a series of protective roofs would prevent bombs from inflicting serious damage.

Below such buildings there would be underground highways and railroads. Water pumps and electrical generators would function in subterranean chambers to insure light and water for the occupants during a siege.

In case of prolonged attack, when the oxygen supply might run out, electric suction pumps, included in the scheme, would draw air into the sealed chambers through charcoal and water filters designed to remove poison gas.

Recently, however, J. B. S. Haldane, British chemist, declared that the danger to large cities from a gas attack has been overestimated. To drop 2,000 tons of gas, a total load of 5,000 tons would have to be carried by the invading fleet, due to the weight of the metal gas containers. This would require thousands of huge planes, he pointed out, and such a fleet could not break through defense squadrons intact.

Nevertheless, the French government is reported to have ordered 15,000,000 gas masks as a protection against such an emergency. It is suggested that masks also may be required by city dwellers to protect themselves against clouds of artificial smoke that would be spread above buildings to hide vulnerable spots such as freight yards, power plants, and water works from enemy bombers.

Invents Safety Crossing to Unsnarl Traffic

NEITHER traffic lights nor stop signs may be needed to govern traffic at intersections of crowded thoroughfares if a new safety crossing, designed by George K. Laham, a twenty-four-year-old inventor of Boston, Mass., is adopted. His scheme is designed for two-way continuous traffic without hazards of crossing accidents.

The inventor with model of his two-way safety crossing. Note entries for right and left turns.

One of the intersecting streets would be bridged at the crossing to permit one stream of traffic to pass over the other without interruption. To permit cars to turn the corners from one street into the other, the inventor has arranged openings through each side of the bridge approaches. Thus a machine approaching the bridge can either continue straight over or enter the opening at the right side of the road to turn into the opposing highway. The turn from the lower highway into the one having the elevated crossing is made by a right turn through the opening at the left side of the bridge approach. Left turns are also possible.

Along the outer edges of the bridge, walks would be provided for pedestrians.

"Electrified Food" Next

A NEW method of cooking, in which electric current passes directly through the food, is being tested by specialists in home economics at the University of Washington. A potato can be baked in one minute and an egg fried in two seconds, it is said, by the new method.

Portuguese Mines Promise New Radium Supplies

RADIUM, chiefly used in hospitals for the treatment of cancer and in research laboratories for studying the spontaneous decomposition of atoms, is the costliest element in the world. At present, its price is about $60,000 per gram, or approximately $1,700,000 an ounce!

Reduction in the prohibitive cost of radium is expected as a result of the exploitation of new radium mines in Portugal, which, it is hoped, will yield about twenty grams of the precious stuff a year. Until now, most of the world's supply has been obtained from mines at Kantaga, in the Belgian Congo, which are owned and operated by a Belgian company. The new Portuguese mines are controlled by a London financier.

Why "A. C." Sets Cost Less to Run

Here, in Cold Figures of the Laboratory, Is Answered the Expense Question That Puzzles Most Radio Fans

By JOHN CARR

Measuring current consumption of an "all electric" set in the radio laboratory of the Popular Science Institute of Standards.

A NEIGHBOR of mine, who has no head for mechanical things, got the radio bug about four years ago. He bought a good six-tube set and all the fixings, including a storage battery, charger, B-batteries, loudspeaker, and antenna equipment.

The dealer installed the outfit and for about six months everything worked beautifully. Then the B-batteries gave out and in hooking up new ones, my neighbor got his wires crossed and blew out a whole set of tubes. A year later the storage battery went bad and he had to buy a new one. The battery should have lasted much longer than that, of course, but he had neglected it.

Last year the A-battery gave out again. And as the tubes in the set were pretty well shot and the B-batteries as well, my neighbor traded in his set for a new electric model.

"John," he said to me a few months later, "I think I jumped out of the frying pan into the fire. I've been doing nothing but buy new detector tubes ever since I got that electric set, and now the rectifier tube has gone dead, too. To be sure, I haven't had any battery trouble to worry about, but it might just as well be battery trouble as to have the blamed tubes burning out all the time. What's the answer?"

My neighbor's radio troubles are typical of the experiences of thousands of radio fans. And thousands of prospective electric set owners have deferred their purchases because of such experiences.

My neighbor spent more than was necessary for radio entertainment while he was using a battery operated set. That was his fault. His radio entertainment for the first year he used his electric set also cost him too much, but he certainly was not to blame for that.

EARLY types of the alternating current heater tube used in the detector socket of most electric sets were not so good. Their life was limited even under ideal conditions, and when used in a locality where the supply voltage varied considerably, they burned out one after another. Even the ordinary alternating current tubes using raw A. C. on the filaments were none too reliable, and the rectifier tubes gave some trouble.

Old-time radio fans will recall that the same situation existed in the early days of vacuum tubes. They cost anywhere from five to nine dollars apiece and you never could tell whether a particular tube would be in your set five minutes, five months, or five years.

NO ONE now questions the reliability of high grade battery-type vacuum tubes, and Popular Science Institute of Standards tests show the latest types of alternating current tubes have reached the same high standard. Whereas the heater type tube used to be the weak spot in any electric set, the tubes now being made are rugged and reliable.

Therefore it is now possible to make a fair and reasonably accurate estimate of the relative cost of operation as between a battery operated set and an equivalent electric set. And, to give the battery set a square deal, let's assume that it receives proper care—not the kind my neighbor gave his outfit!

It is, of course, impossible to figure depreciation on a radio receiver. The market value today of any set purchased three or four years ago is hard to estimate. Probably you couldn't sell such a set for one tenth of its original cost. Yet mechanically and electrically it may be just as good as the day it was bought. So we shall consider just the operating costs.

Assume we have two six-tube receivers —one run by batteries, the other full electric—each set using a 171-A power tube in the last audio stage. Allow three hours a day operation, which totals a trifle more than 1,000 hours a year.

The rated life of a vacuum tube is 1,000 hours. Some last more, some less. We'll assume that, whichever type set you have, you'll need a new set of tubes once a year.

Now let's see how it works out for the battery set. Tubes will cost you $9.50 a year. Keeping the A-battery adequately charged with a two-ampere charger will cost, for current at the ten-cent-an-hour rate, $2.52. You'll need a new charger bulb once a year at $4.00. You'll use two sets of heavy duty B-batteries at a cost of $24.00. And if to that you add $3.00 as the depreciation of a $12.00 A storage battery that lasts four years, the total yearly operating cost for the six-tube battery set is $43.02.

If, instead of using dry cell B-batteries, you use a high grade B-eliminator, the $24.00 item for B-batteries can be removed from the list and instead you'll add $3.50 for the rectifier tube you'll wear out in a year and $2.15 for the current it will consume. The total for the battery type set, operated with a storage A-battery and B-eliminator, therefore will be $24.67.

Considering the electric set, we find that a new set of tubes each year will cost $17.00, but the only other expense will be $5.27 for the electric current required to run it. The total, therefore, is $22.27, two dollars less than the operating cost of a battery type set, even when the latter uses a B-eliminator!

ONE reason why the electric set, although it uses more expensive tubes, actually costs less to run, is that current production from a storage battery is a relatively inefficient process. The battery itself, under radio conditions, is only about seventy percent efficient, and the tube-type battery charger is only about twenty-two percent efficient.

Of course, these figures cover only one set of conditions. If the electric light rate is higher or lower the totals will be different. And if the sets are used a greater or less number of hours a day the totals will be different. It is interesting to note, however, that cost of electric set operation varies directly with the number of hours it is used, whereas with the battery set this is not true because batteries depreciate even when idle.

How *to* Kill Squeals *in* Your Set

Here Are Four Easy Ways to Control Oscillation, the Mysterious Plague That Mars Radio Enjoyment

By ALFRED P. LANE

WE COULDN'T have modern radio broadcasting at all without the electrical oscillations produced by vacuum tubes. But however valuable that feature may be for broadcasting, it certainly is a nuisance in radio receiving.

If it weren't for that tendency toward oscillation it would be no trick at all to hook up a radio receiver that would bring in China any time you wanted it—provided your ears could stand the terrific barrage of static that would be brought in by so powerful a set. All you'd have to do would be to add stage after stage of radio-frequency amplification till you reached the desired power.

As things stand, however, every time you add another vacuum tube in a stage of radio-frequency amplification, your troubles with unwanted oscillations are magnified at such a rate that you soon reach a point where the tendency toward oscillation becomes uncontrollable.

To most radio set builders and owners the oscillations that cause squeals and howls, and inevitably ruin tone quality, seem like some mysterious plague. And often they waste much time in seeking a magic cure.

Testing oscillation characteristics of radio tubes in the laboratory of the Popular Science Institute of Standards.

SQUEALS and howls really are a form of radio disease, and the name of the germ that causes the trouble is "feed-back."

Did you ever hold a telephone receiver against the mouthpiece of the instrument? It's a dirty trick to play on the operator because the instrument immediately emits a bloodcurdling shriek that nearly ruins the poor girl's eardrums. It is, however, a fine illustration of what feed-back will do. The tiniest noise in the telephone receiver is fed into the transmitter which, of course, reproduces it again in the receiver which, in turn, hands it back to the transmitter louder than ever—and so on in a vicious circle until what originally was a sound so weak you couldn't hear it soon becomes a terrific howl.

This effect on an ordinary telephone is closely paralleled in a radio receiver when you happen to have a particularly microphonic tube in the detector socket and you bring the loudspeaker too near the set. The vibrations from the loudspeaker work back into the electrical circuit by shaking the detector tube, and a howl results.

This form of oscillation or regeneration is mechanical in nature because the action depends on actual mechanical vibrations in the air or in some more solid substance.

The kind of oscillations that take place in a vacuum tube are, however, purely electrical in action, there being no mechanical motion involved other than the movement of electrons.

The form of oscillation with which most radio fans are familiar is that produced by a tickler coil in a regenerative receiver. As you turn the knob that rotates the tickler coil, the strength of the received broadcasting signal increases up to a point at which the tube suddenly breaks into oscillation and an audible squeal is produced.

Connecting a grid suppressor to grid terminal of radio-frequency tube socket so as to stop squeals.

WHAT happens is that the signal received on the grid of the tube reproduces itself in amplified form in the plate circuit of the tube. The tickler coil is in the plate circuit, and when you move it into magnetic coupling with the grid coil the signal is electromagnetically fed back into the grid circuit and you get an electrical equivalent of the same round-and-round action obtained mechanically by the telephone receiver placed against the mouthpiece or by the loudspeaker vibrations acting on the detector tube.

There are, however, regenerative circuits containing no tickler coil and in which the regeneration is obtained by capacity feed-back through a condenser.

It is therefore possible to make a vacuum tube oscillate either by electromagnetic coupling or by capacity coupling. In the multi-stage radio-frequency amplifier both forms of feed-back normally are present to cause trouble unless special precautions are taken to eliminate them, to balance them, or to deliberately introduce losses into the circuit that will prevent the tube from oscillating even when other conditions are favorable to oscillation.

Electromagnetic coupling is, of course, the action that takes place between the coils that are used to tune the different stages of radio-frequency amplification. It can be prevented either by adequate shielding or by so placing the coils that the coupling is reduced to the minimum or to such a low figure that it will not cause trouble.

In the original neutrodyne circuit magnetic coupling was reduced by placing the coils at carefully calculated angles. In many modern receivers this principle, a combination of shielding and careful placing of the coils, is resorted to.

IF YOUR receiver is factory built and you are having trouble from squealing or distortion due to oscillation there is nothing you can do about either shielding or coil angle. The manufacturer of the set probably has done all he can along these lines and any changes you may make are likely to make matters worse. If, on the other hand, your receiver is homemade, there is a chance that you may not have followed instructions as precisely as you should; and it is often pos-

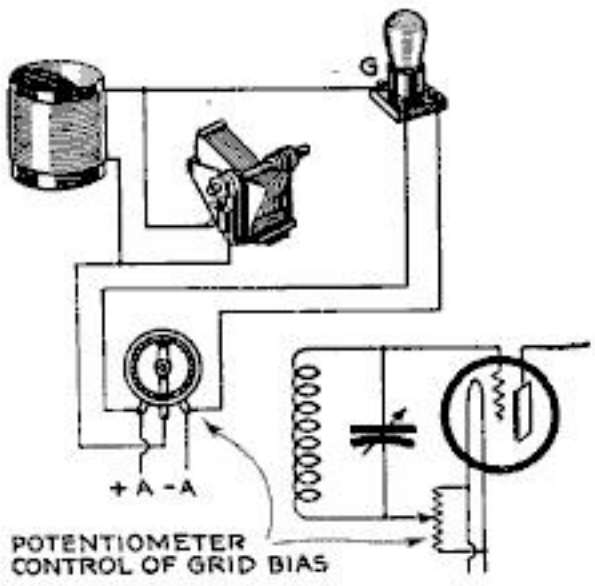


Fig. 1. The oldest form of regeneration control — positive and foolproof, but not efficient.

sible, therefore, to correct a bad-acting home-built set merely by a slight change in the position of the coils or the shielding.

Sometimes even when you carry out the setting of the coil angles and the spacing very accurately, if you wire the set in some peculiar way you may introduce unbalancing capacity effects that can be offset by changing the spacing or angles of the coils.

THE main source of capacity feed-back is the actual electrical capacity between the elements in the tube. In addition to that there is the capacity between the plate and grid wiring. You cannot do anything to eliminate the internal capacity of the tube, of course, but external capacity can be pretty well removed by careful arrangement of the wiring and the use of proper shielding.

But while the internal capacity of the tube cannot be eliminated it is possible to introduce other elements in the circuit either to neutralize its effect or to overcome it literally by strong arm methods.

The oldest form of regeneration control is shown diagrammatically in Fig. 1. This is the potentiometer method. A potentiometer is used to control the grid bias or voltage applied to the grid of the tube. The potential or voltage on the grid governs the tube's ability to amplify, and as the arm of the potentiometer is swung from the negative toward the positive end of the potentiometer, the tube becomes less and less effective. The more the tube amplifies the greater is its tendency to oscillate, so that reducing its amplification automatically controls regeneration.

About the only good feature of this system is that it is positive and foolproof. It is not efficient and causes excessive drain on the B-batteries, because throwing the grid positive to prevent oscillation greatly increases the flow of B-battery current through the tube.

Lowering the B-battery voltage also decreases the tendency of the tube to oscillate. This method of control is shown in Fig. 2. A variable high resistance is placed in the lead to the plate of the radio-frequency amplifier tube and turning the knob increases the resistance, cuts down the voltage applied to the plate, and so stops oscillation. The by-pass condenser is necessary to provide a path for the radio-frequency currents. In this diagram as well as in Fig. 1 only the wires in the circuit actually involved are shown.

Reducing the voltage applied to the plate of the tube is a more satisfactory control than is the method in which the grid bias is varied. A higher degree of amplification can be obtained, and B-battery current is conserved by cutting down the plate voltage.

The neutrodyne method of overcoming the tendency toward oscillation caused by the internal capacity of the tube is to introduce a small external capacity in such a way that the flow of current through this external condenser

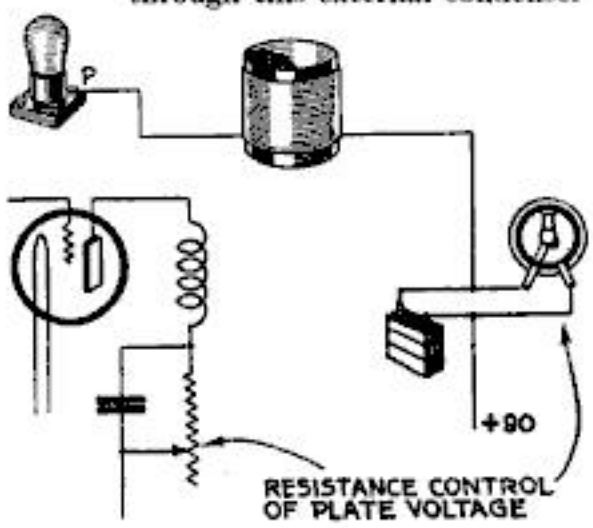


Fig. 2. Here a variable high resistance is placed in the lead to plate of radio-frequency tube.

opposes the effect produced by the internal capacity. Fig. 3 shows the common method of neutralizing tube capacity in diagram and also a picture of the parts and wires actually involved. In the original neutrodyne hook-up, the small neutralizing condenser was connected between the grid of the preceding tube and a tap on the secondary coil of the tube following. The method shown, or variations of it, has several advantages over the older method. It can be applied to any circuit merely by doubling the number of turns in the plate or primary coils of the radio-frequency transformers, with the extra turns added to the plus B end and wound in the same direction.

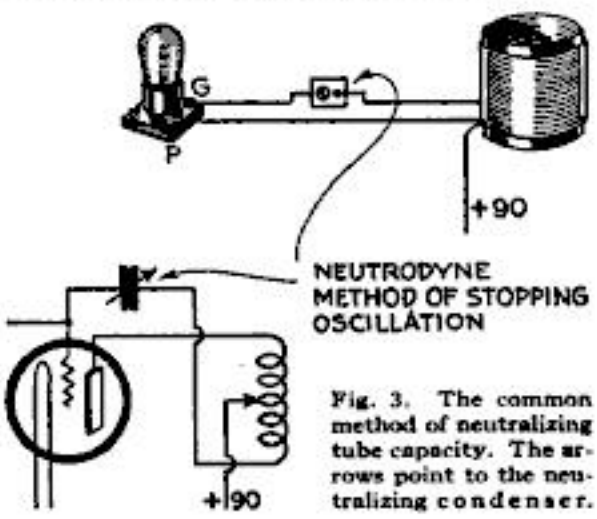


Fig. 3. The common method of neutralizing tube capacity. The arrows point to the neutralizing condenser.

THE remaining method of getting rid of unwanted oscillations is to deliberately introduce a definite amount of loss into the circuit. This usually is done both in factory built and home assembled radio receivers by inserting grid suppressors in the grid lead. A grid suppressor simply is a fixed resistance—preferably noninductive and noncapacitive.

Fig. 4 shows the location of the grid suppressor in the circuit. The tuned circuit, of course, consists of the tuning coil and the condenser. The signals developed in this circuit are forced to pass through the resistance to get to the grid. This reduces the strength of the signal to some extent, but it also puts a resistance in the path of any incipient oscillation. Fortunately, the effect of the grid suppressor in preventing oscillation is more marked on the lower wave lengths where the tendency toward oscillation also is most pronounced.

BECAUSE the connections are so extremely simple, adding grid suppressors to the circuit is the simplest method by which you can stop oscillations in a receiver already built. All you have to do is to cut the wires leading to the grid terminals of the radio-frequency tube sockets and connect in the grid suppressors. In severe cases the value of the resistance necessary to stop oscillation may be as high as 1,500 ohms or more. Of course, best results are obtained with resistances just high enough to stop oscillation without making the set too dead.

In cases where there is doubt as to the proper value, you can connect grid leak mountings into the grid circuits and then vary the values of the resistances until you get the best average results. Then leave it alone.

In any case, results will not be good if too much dependence is placed on the method of preventing oscillation. If, for example, the tuning coils are so placed that there is excessive coupling, it would be necessary to use such high resistance grid suppressors that the receiver would be notably lacking in sensitiveness and none too selective.

IT IS, of course, possible to use more than one method of controlling oscillation in the same circuit. Grid suppressors may be added to a circuit that is already neutralized, and, in addition, plate voltage control could be installed. Sometimes this actually is done in circuits using more than two stages of radio-frequency amplification.

In fact it is quite common for manufacturers of large radio receiving sets using three or more tuned and neutralized stages of radio-frequency amplification to add grid suppressors to one or more of the radio-frequency stages. The use of relatively low resistance grid suppressors in such a circuit often is desirable in order to eliminate the need for a delicate balancing operation each time a tube is changed in the set.

And there we are right back to where we started: If you attempt to use too many stages of radio-frequency amplification you must also do so much to the circuit to prevent it from oscillating that the effect of the extra tubes is wasted!

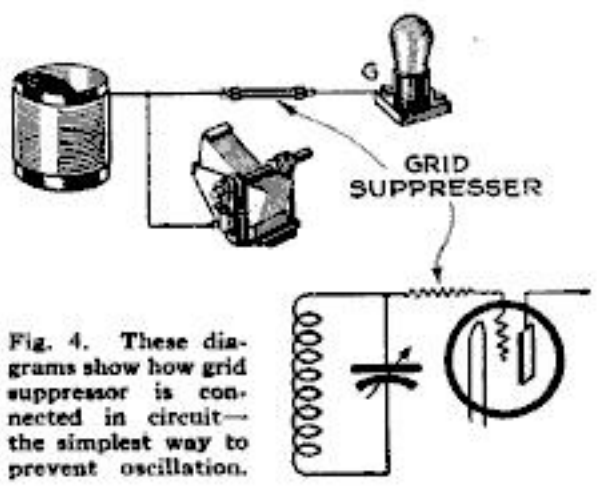


Fig. 4. These diagrams show how grid suppressor is connected in circuit—the simplest way to prevent oscillation.

What Is Your Radio Problem?

Here Are Some Useful Ideas That May Help—When the Storage Battery Dies—Why the Low Notes Disappear

A STORAGE battery is much too perfect for its own good. Unlike most other pieces of apparatus, it goes on giving good service no matter how badly it is treated, until in the end it literally goes to pieces on the job.

If you apply too much current to the filament of a vacuum tube, it burns out with discouraging promptness. Turn the knob on the dial too far and it is likely to come off in your hand. But you can let the battery stand around half charged for months and it will still operate the radio set, although such treatment probably will cut its normal four- or five-year life to a year or less.

When a storage battery finally reaches the point where a long continued charge does no good, throw it away and get a new one. No use trying to rejuvenate it, because usually there is nothing left to rejuvenate. Either the plates have become so covered with sulphate that they can never be cured, or they have actually fallen to pieces. There is no known chemical that will remove the sulphate without also destroying the active material in the plates, so *don't waste money on any material sold for the purpose of rejuvenating storage batteries.*

Bringing Out Low Notes

MODERN broadcasting stations of the better class transmit with reasonably uniform strength all audible frequencies, from the low notes of the organ to the highest of the piccolo. Consequently, if you don't get all these notes, the fault lies with your own receiving equipment. And the loudspeaker is not always to blame. Frequently the trouble is in the radio receiver itself. If it is extremely selective it probably cuts off the higher audible tones to a marked extent. Many sets do not give adequate reproduction to the low tones below 150 vibrations per second, which is about the lowest note of a cello.

That explains why some radio fans have been disappointed in the results obtained from a dynamic speaker. The virtue of a dynamic speaker lies in its ability to reproduce a wide range of tone frequencies, but this ability is of no value if the speaker is connected to a set incapable of feeding the very low and the very high notes to it.

Similarly, some fans have had discouragingly poor results with baffle boards fitted to their cone speaker units. No matter how big the baffle board, the low notes remain conspicuous by their absence. The trouble, of course, is that the baffle board cannot manufacture the low notes. All it can do is to help impress them on the surrounding air if they are produced by the speaker.

Don't do this! Attempting to rejuvenate an old worn-out storage battery with any preparation sold for the purpose is a waste of money.

This explains why there is no use in fitting a baffle board to the ordinary magnetic cone speaker. The speaker gives little or no response at the frequencies at which the baffle board is useful.

High frequency cut-off, or loss of the higher notes, takes place in the radio-frequency amplifier stages and to some extent in the detector stage, but lost low notes can be charged to poor audio-frequency transformers almost every time.

If you have purchased a good dynamic speaker unit and you find you cannot get the low notes even with the aid of a good baffle board, the trouble undoubtedly is in your set and not in the speaker.

Imitation Static

THE simplest way to determine where interfering noises are coming from is to disconnect your antenna and see what happens. If the noises continue unabated, something is wrong with your set. If they stop, static is to blame and there is no remedy. There are just two exceptions to this rule. The noise may be caused by the operation of near-by electrical machinery, in which case something probably can be done about it, if you can locate the offending machinery. The other possibility is a corroded antenna lead-in wire. It is desirable, of course, to have the antenna and lead-in consist of a single, continuous piece of wire, but frequently the lead-in is a separate piece of wire joined to the end of the antenna by twisting. The lead-in usually dangles loosely so that there is no strain on the joint, and after awhile corrosion creeps in and the joint goes bad, causing scratchy noises in your receiver.

It sometimes happens, where several antennas are strung on a single roof, that one will sag sufficiently to come in contact with another wire just below it. As the wind swings the wire to and fro, the scraping contact between the two wires will produce an excellent imitation of real static.

Two Tones at Once

ONE of the most amazing things about a radio loudspeaker is that it can reproduce the music from several different instruments at the same time. The reason it is possible for a simple paper diaphragm to do this is that the various vibrations combine to form what amounts to a single equivalent motion for the paper.

A careful analysis of the actual motion of the diaphragm will show that it does not move back and forth in a uniform motion. Instead it trembles back and forth in a highly irregular way in reproducing the compositive sound wave. Pictorially, the motion of the diaphragm would appear as a mere jumble, but the resulting sound wave has the same effect on the human ear as though all of the different instruments were being heard.

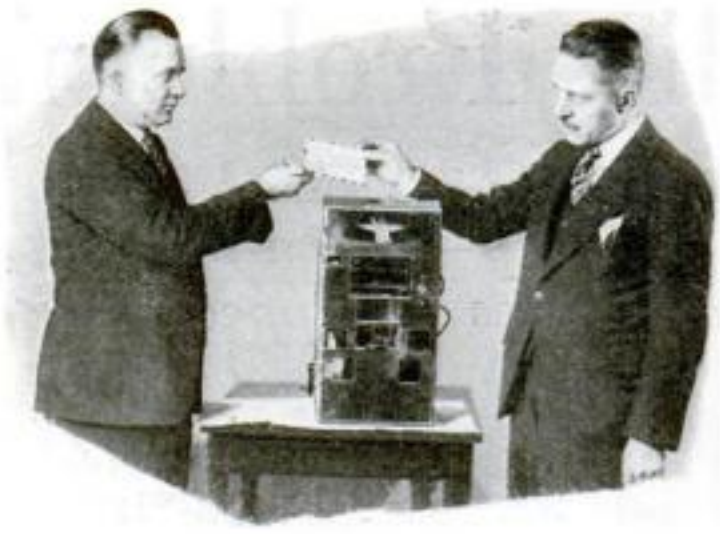
As a matter of fact, if you analyzed the air vibrations caused by the playing of a large number of instruments at the same time, the recording instrument would show that the molecules of the air were vibrating in an irregular fashion just as does the paper cone of the loudspeaker.

A B C's of Radio

THE filament in a radio vacuum tube is the heart of the tube. When heated by the flow of electric current through it, electrons flow from the filament toward the plate.

Early types of vacuum tubes contained plain tungsten filaments. Later it was discovered that a small amount of thorium added to the tungsten greatly increased the electron flow. Now the oxide coated filament, which is operated at a dull red heat, is replacing the thoriated tungsten filament.

The heater type alternating current tube differs from the conventional tube only in that the electron emitting surface is heated by a plain tungsten filament that is electrically insulated from it.



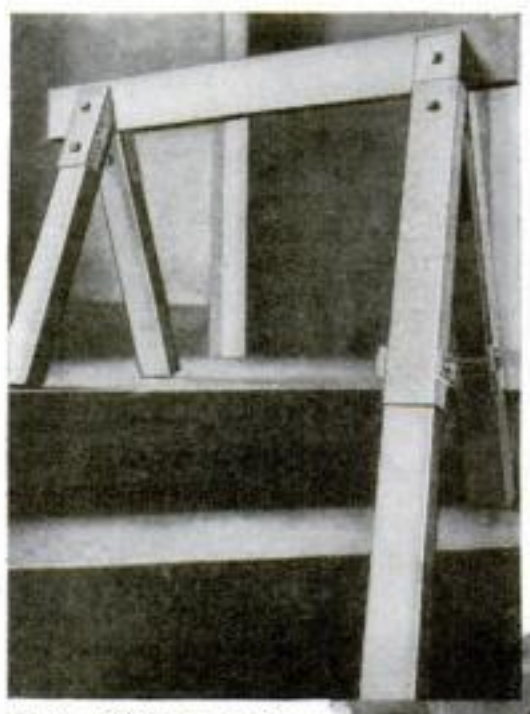
Air Mail Stamp, Music, and Pictures—for a Nickel

AN AUTOMATIC stamp vending machine that not only delivers a red, white, and blue envelope and an air mail stamp but plays music and shows pictures, as an accompaniment, has been devised by an American inventor, Francis C. Roberts. He is seen at the left in the photograph, demonstrating the operation of his machine in Washington, D. C.

Postal authorities will exhibit the ingenious device in various parts of the United States to stimulate interest in sending mail by the sky route. Envelope, stamp, concert, and show are supplied when a nickel is dropped in the slot.

An Adjustable Sawhorse

THIS latest aid to carpenters—a sawhorse with sliding extension legs—will also delight the man about the house who spends a part of his week-end in the attic or cellar with hammer and saw. It can be set up in the most difficult and cramped positions—even on a flight of stairs, as pictured at the right—and will not wabble or fall. Remove two nuts, and the legs slip off for storing in small space.



How adjustable sawhorse stands firmly on stairway.

"Silent" Sounds Used to Analyze Liquids

SOUND waves too high-pitched to be heard by the human ear now analyze liquids in a new method of startling precision announced by Dr. J. C. Hubbard, Johns Hopkins University physicist. By passing them through a vessel filled with an unknown fluid, a chemist can tell what the liquid is, what kinds of chemicals it contains, how much of each, and whether the liquid is adulterated with any impurity.

The new process was developed in the laboratory of Alfred Loomis, New York banker and experimenter of Tuxedo Park, N. Y., whose work with sound waves has been described previously in POPULAR SCIENCE MONTHLY. Dr. Hubbard found that no two substances transmit sound waves at the same speed; that the speed is, in fact, a characteristic property of each individual substance; and that it can be measured precisely. The result is a new method of analysis that may supplant hours of work in a chemical laboratory.

House Plants Thrive on Soap Baths

PLANTS that will flourish in one man's house won't grow in another's. It all depends on the thermometer, declares H. W. Becker, of the New York Botanical Garden.

In the dryness of an overwarm steam-heated home, a few plants will grow successfully; palms, ferns, asparagus, cactus—and even a pineapple! The pineapple should be purchased in June, and should have a long green top. This top is snipped from the fruit, shorn of its lowest leaves, and planted next day in a four-inch pot of sandy soil. Kept wet in a shady spot; it thrives on heat.

A cool room with a sunny window offers greater possibilities. Here may be grown camelias, carnations, myrtles, and oleanders, as well as fuchsias, geraniums, hyacinths, tulips, lemon and orange plants in blossom, pansies, snowdrops, violets, and Mexican primroses. All of these perish as the thermometer climbs above the seventy degree mark.

Plants should have a regular bath to thrive, Becker says. A one-inch block of laundry soap dissolved in a pint of hot water, with a teaspoonful of kerosene added, is used to wash the leaves. The plants are kept in the shade for a day or two, then rinsed.

Movies Look More Real if You Close One Eye

WATCH the movies with one eye, if you crave realism.

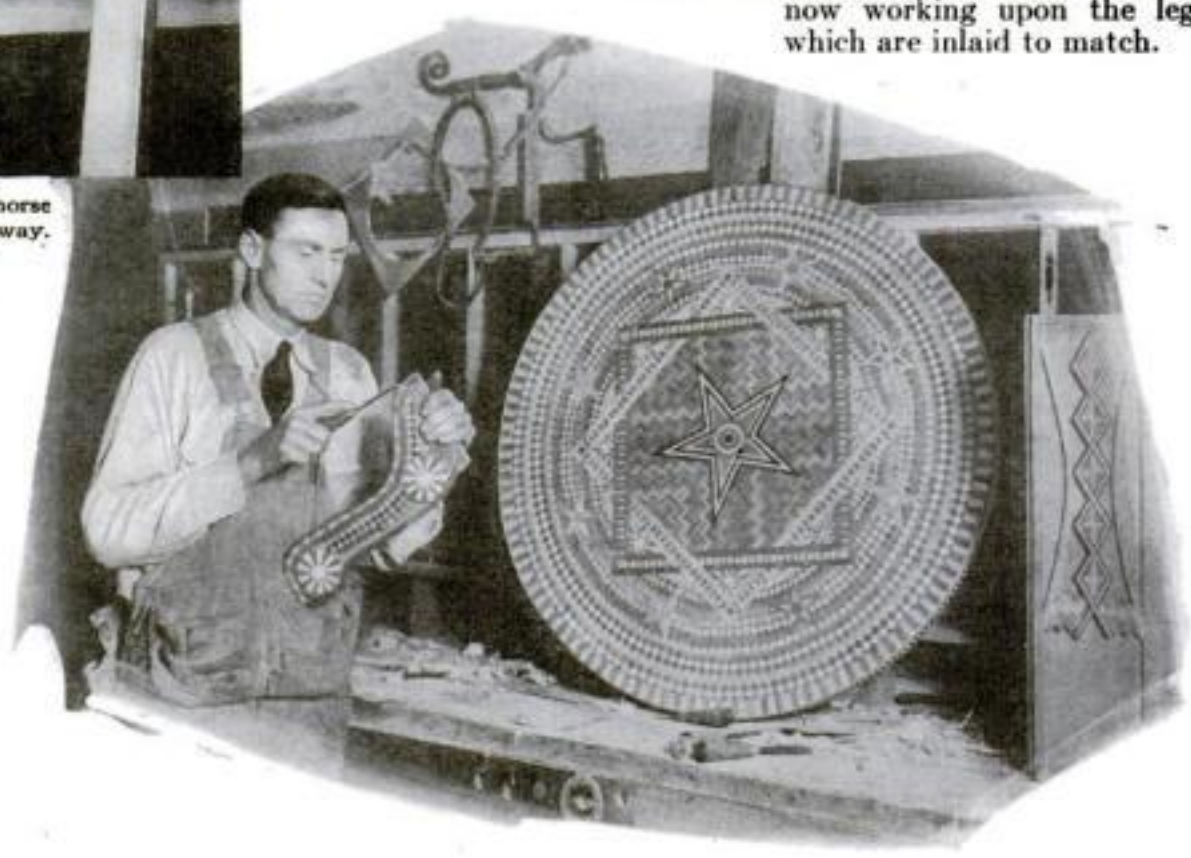
That odd advice was given by I. G. Priest, of the U. S. Bureau of Standards, at a recent joint meeting of the American Physical and Optical Societies. The effect, he explained, is to give an illusion of depth or perspective ordinarily lost in a photograph taken with a single-lens camera. It enables you to see the scene as it looked to the camera, with near objects standing out in relief against a distant background. The same illusion is possible if you look at an ordinary snapshot print with one eye, particularly if the usual white margin is concealed.

Several attempts have been made to exhibit stereoscopic motion pictures, but the special eyepieces required have proved too irksome for the average theater-goer. One of the closest approaches to this ideal is an ingenious illusion recently described by Dr. Herbert E. Ives, of the Bell Telephone Laboratories. A battery of cameras is used to take a picture, and in the theater another battery of projectors arranged in a semicircle flash the resulting picture—which enables a spectator actually to "see behind" a tree or other solid object—on a special screen. The apparatus, however, is cumbersome and costly.

Spends 14 Years Building Inlaid Table Top

AN OLD Chinese smuggling junk of the Yellow Sea supplied one of the 5,793 pieces of wood that went into an inlaid table top which has taken Frank Ferris, of Olympia, Wash., fourteen years to complete. The different woods came from nearly every continent in the world.

Beginning the job during the World War, and working in spare hours, Ferris polished and fitted together the pieces into an elaborate pattern of stars and oriental rising suns, formed with different colored woods. After completing the top of his "table of the continents," Ferris is now working upon the legs, which are inlaid to match.



Frank Ferris, of Olympia, Wash., working on one of the legs of his remarkable inlaid table, on which he already has worked for fourteen years. In the top alone are 5,793 pieces of different woods.

"Silk" Gowns of Asbestos May Become the Style

SHIMMERING dresses that look like silk but are insulated against acid and fire were forecast recently by Professor Paul Q. Card, of the industrial chemistry department of the Philadelphia College of Pharmacy and Science, who believes we shall eventually wear asbestos clothes.

The Romans, the first people known to have used asbestos, are said to have woven the mineral fibers with linen to make burial cloth which retained the ashes of bodies burned on funeral pyres. Professor Card believes it will be possible to produce from the fibrous hornblende lustrous cloth resembling silk, but having the wearing quality of the homespun of frontier days. Such material, he suggests, could be sponged clean with a wet cloth and would cost less than other materials of which clothes are now made.

Silver to Purify Water

BY INJECTING silver in a specially prepared form, Dr. Georg Krause, an engineer of Munich, Germany, says he has found a new way to purify drinking water. About a twentieth of an ounce of silver, he claims, is sufficient to disinfect 2,500,000,000 gallons of water.

Ice Jam Defies Thousand Pounds of Dynamite

ENOUGH dynamite to drive a twelve-inch projectile weighing half a ton through three feet of solid steel was unable to blow up an ice jam that clogged a creek near Buffalo, N. Y., early this year. A thousand pounds of the explosive was set off at different points, tearing huge holes in the ice cakes but failing to clear a channel for flood waters rising behind.

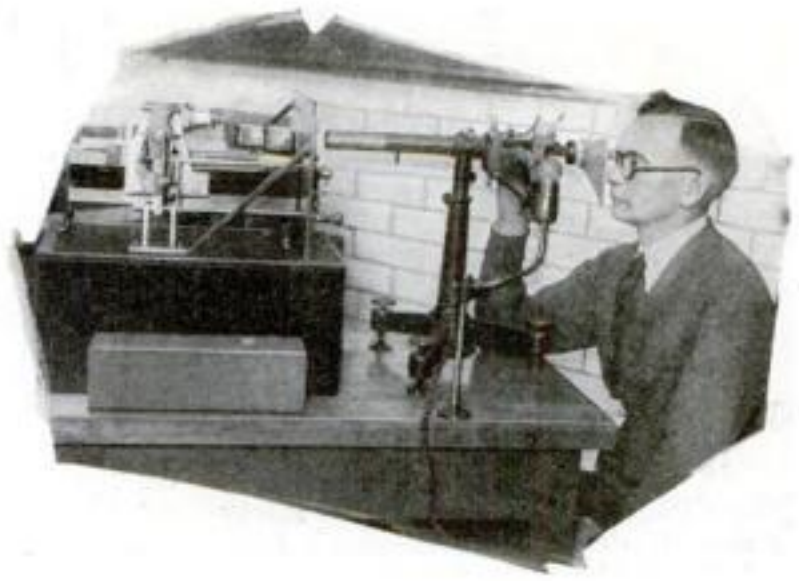
A hundred families were driven from their homes, three bridges were destroyed, and damage estimated at a million and a half dollars was caused before the jam broke and the water subsided.

A new method of destroying ice jams by the terrific heat of ignited thermit, a mixture of powdered aluminum and iron oxide, was described in the April issue of POPULAR SCIENCE MONTHLY.

Saves Labor on Ironing Day

BY PLATING the base of electric irons with chromium, the new nontarnishing white metal widely used for automobile trimmings, an Eastern manufacturer claims to have diminished by thirty percent the effort required to push one across an ironing board.

Taking into account the number of the new irons to be produced during 1929, it is estimated that the improvement will save American housewives 20,800,000,000 foot-pounds of energy this year—which, translated into everyday language, means energy sufficient to drive the steamship *Leviathan* at full speed for more than eight minutes.



Divides Inch into Millionths

THE smallest mark you see on an ordinary ruler measures one sixteenth of an inch. Imagine an instrument so accurate it will divide that small space into 62,500 equal parts, each exactly one millionth of an inch, and you will have an idea of an amazing invention recently perfected by the U. S. Bureau of Standards, in Washington, D.C.

The machine measures by means of light waves. Walter B. Emerson, an expert of the Bureau, who is seen above with the invention, assures us that if the world's standard meter, marked upon a platinum bar and carefully guarded at Sevres, France, and all copies of it, were destroyed, new and equally accurate standards could be produced with this instrument.

A Handy Golf Ball Holder

A NEW attachment for golf bags keeps the old and new balls separate and the new ones instantly available. It consists of two rust-proof metal cylinders, one on the outside, the other inside the bag. The outside "gun" carries a dozen new balls. Pressing a device at the bottom releases a ball when needed. The inner cylinder holds the used balls.

Releasing a new ball from holder.

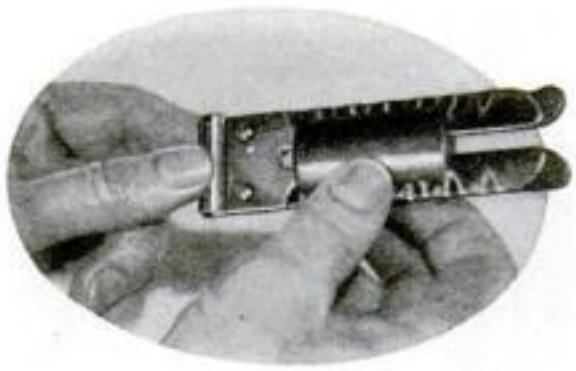
This remarkable photograph was snapped at the instant a dynamite blast was set off in an attempt to break a destructive ice jam near Buffalo, N. Y. The wreckage shows the havoc wrought by the ice.

Toads Do Not Cause Warts

THE time-honored belief that toads cause warts is discredited by investigations by Karl P. Schmidt, assistant curator in charge of reptiles at the Field Museum of Natural History, Chicago. The idea that handling toads is related to having warts, he says, evidently grew from a simple analogy between the wartiness of toads and the existence of warts on the hands of small boys, who often play with toads.

The skin of a toad does secrete a kind of poison which is a violent irritant to the eyes and mouth but not to the skin of man, Schmidt states. This probably is a means of protection against enemies.

A second widespread belief, to which attention was called not long ago when a toad was reported to have been discovered in the cornerstone of a Texas courthouse, is that these animals can live for decades imprisoned in wood or stone. This belief is also without foundation, Schmidt says, and suggests that the toad's habit of backing down crevices, especially to hibernate, accounts for such tales.



Sharpens Two-Edge Blades in the Safety Razor

SHARPENING a double-edged safety razor blade without removing it from the holder is the achievement claimed by the inventor of a new device which can be carried with the shaving kit. The sharpener consists of sliding metal strips notched to move between the two convex parts of the blade holder, and fitting over both faces of each blade edge. Moving the device back and forth a few times is said to hone and sharpen both edges.

Hundred Different Kinds of Colds May Get You

A HUNDRED people may have colds and each may have a different kind. Evidence of this was revealed recently by two British experimenters, Dr. David Thomson and Dr. Robert Thomson, working in the Pickett-Thomson Research Laboratory, in London.

For eight months they kept daily records of all the germs found in the throats of their fellow workers in the laboratory. These germs were fed special food and studied under the microscope. Those causing colds of various types, from "head colds" to influenza, were given special attention and their habits and characteristics catalogued. As a result, the investigators concluded that at least a hundred distinct types of cold-producing germs exist, each able to cause feverish throats or nose infections.

Wanted—a Foolproof Style of Handwriting

CAN you invent a new system of handwriting—one that cannot possibly be misread, yet is easy and speedy to write? If so, there are millions of dollars in the idea—in the saving that such a system would bring to department stores, according to P. A. Best, managing director of one of London's large retail shops.

Although the advent of the typewriter has banished illegibility from many business records, Best declares, sales slips in retail stores still are scrawled in hopeless hieroglyphics. The store manager is faced by a distressing dilemma; whether to allow errors to continue and follow the costly practice of correcting them afterward, or to insist on better handwriting from his employees at the price of slowing down transactions. Even if he wished to employ only persons with good handwriting, few such persons exist! Present school courses lay little importance on teaching good penmanship, says Best. The only solution, he suggests, lies in the invention of a brand-new alphabet system, to be taught in the schools, by which even careless persons can learn to write fast and foolproof records.

An Aerial Lighthouse That Never Can Fail

THREE times as reliable as the ordinary floodlight, a new airport lighthouse has been erected to help night flyers come to ground at Bolling Field, on the outskirts of Washington, D. C. The monster floodlight has three 10,000-watt lamps, only one of which is needed to turn night into day. The other two are reserves which, if needed, flash on automatically one after the other. Thus, if one lamp gives out, another instantly goes into action, so that there is no possibility that the field will be plunged into darkness as an airplane is landing.

This powerful three-lamp floodlight guides night flyers to a safe landing at Bolling Field, Washington, D. C.

Chestnut Blight Hits Tanning Industry

A BLIGHT that is killing chestnut trees of this country is worrying the tanning industry, according to Dr. C. A. Browne, of the U. S. Department of Agriculture. Half of the twenty million dollars' worth of materials for tanning the leather produced in America comes from the chestnut, and the decreased number of trees is forcing tanners to seek substitutes. The Chemistry Bureau of the Department is investigating the use of mangrove, saw palmetto, and canaigre, a weed of the dock family, to replace the chestnut.

Stencil Machine Paints Designs on Walls

LEAVING "footprints" in the form of painted designs, a wall decorating machine that is pushed up and down the walls of a room is said to accomplish as much as a decorator, working by hand, would do in two days. The device is a paint stenciling machine, running along on little wheels, and feeding the paint automatically. The inventor, Baron D. von Loe, of Hamburg, Germany, recently brought his invention to America and demonstrated it in New York City. He explains that it can be used with different stencils to paint a variety of designs.

Rolling this stencil machine along the wall paints a decorative pattern in a short time.

They Turn on the Radio to Predict Weather

BY TURNING on their radio receivers at sunset, residents in Morgantown, W. Va., report they can predict the weather for the following day. If the intensity of radio signals from station KDKA, Pittsburgh, Pa., falls after sunset, the next day brings clearing weather; if they rise in intensity, it indicates rain.

At the West Virginia University, located in Morgantown, Dr. R. C. Colwell made a series of curves showing how signal intensity varied on different evenings and recorded the weather the next day. Out of forty tests, thirty-eight gave the correct prediction and the other two were nearly correct.

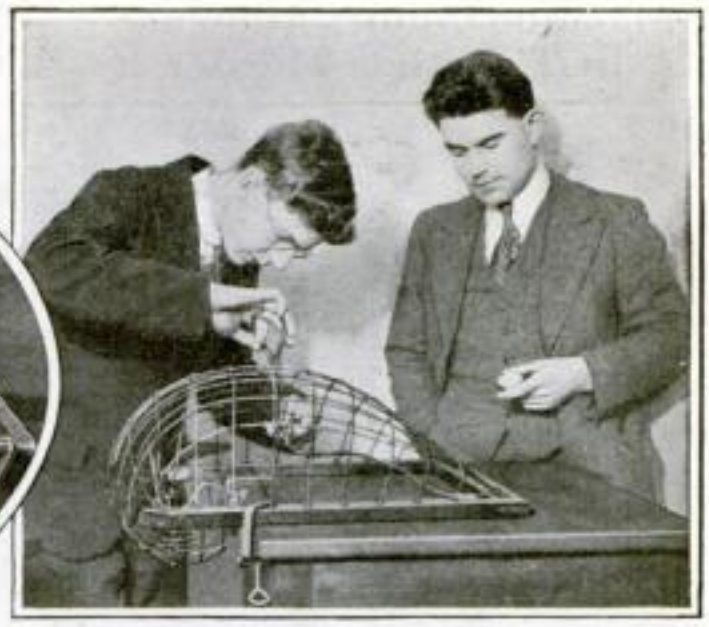
Dr. Colwell believes that as high and low pressure areas which cause weather changes sweep across the continent from west to east, they are accompanied by some electric condition that affects radio reception. He suggests that these areas reach Pittsburgh and Morgantown at the same time, since the two cities are on the same meridian. The inference is that a high pressure area, bringing clear weather, weakens the radio signals at night, while a storm-producing low pressure area has the opposite effect.

Whether other localities may predict weather by the same means remains to be determined.

New Tests Pick the Best Man for the Job

A test of coördination—dropping blocks in a hole and pressing a pedal at the same time.

Measuring nervous and muscular control in tracing curved patterns with a pivoted bar.



This takes patience and perseverance. With tweezers inserted between bars of a cage, the applicant tries to move screw eyes the length of a crooked wire within.

DISCOVERING the natural ability of applicants for jobs and placing them in positions where they will be happy is the aim of a series of scientific puzzles and tests designed by a London, England, psychologist. They are especially useful, he says, in finding employees of the right type for large factories where machine operators are needed.

One of the ingenious tests, designed to reveal the applicant's patience, perseverance, and ability to concentrate, makes use of a small cage inclosing a crooked wire, on which are strung a dozen screw eyes. The applicant, working with a pair of tweezers through the meshes of the cage, must move the screw eyes from one end of the wire to the other. A man with a stop watch in his hand stands beside him and records the time required to accomplish the task. The test also shows the ability of the one being tested to handle tweezers, which is important in some sorts of factory work.

Another device, for determining muscular and nervous control, is a pivoted metal bar holding a pencil. Controlled by handles on either side, the bar can be moved in any direction. The applicant, grasping the handles, attempts to move the bar so that the pencil will follow various circles and angles that are stamped on a sheet of paper. Deviations from the lines of these patterns indicate lack of muscular control.

THE ability to coördinate movements of feet and hands, needed in operating some machines, is tested with a third device, consisting of a box with a small hole in the top and connected with a pedal near the floor. The applicant is given a number of little blocks and told to drop them, one at a time, into the hole from a certain height. As each block is dropped, he must push the pedal with his foot. The time required to drop all of the blocks in the hole measures the natural ability of the applicant for work that requires such coördination.

The times and records of the three tests are said to give the employer a fairly accurate idea of the abilities of the applicant and to save him money which would be spent in training would-be employees who are unfit physically or psychologically for the work required.

Her Ring a Vanity Case

A RING that is a vanity case as well has been introduced in Hollywood, Calif. In place of the usual stone or signet is a small oval box containing rouge. Under the lid of the box is a tiny mirror to aid in applying the make-up. The case can be refilled with rouge of a color to suit the user as often as is desired.

What could be handier? A tiny mirror and a box of rouge—all contained in "pinkie" ring.

One-Celled Amoeba Swims by Dissolving Itself

EVER since Rösel von Rosenhof, an early German microscopist, wrote the first description of the amoeba—the one-cell organism which is the simplest form of animal life—in 1755, scientists have been at a loss to explain how this minute creature moves about without legs, fins, or any other usual or visible means of locomotion. The theory accepted by most zoologists was that the tiny animal simply pushed itself out in front and contracted itself in the rear.

Recently Dr. S. O. Mast, of Johns Hopkins University, in Baltimore, Md., upset this hypothesis. Extensive study and observation of the amoeba, he announced, had shown him that it moves around in the ponds and streams in which it lives by dissolving itself at the rear, transferring the dissolved substance to the front, and solidifying it there. This operation the amoeba repeats until it attains a fairly satisfactory rate of speed.

The professor admitted that the problems of how this strange process is accomplished, and whence the amoeba derives the energy with which to do it, remain to be solved.

Ages Wine by Electricity in a Few Hours

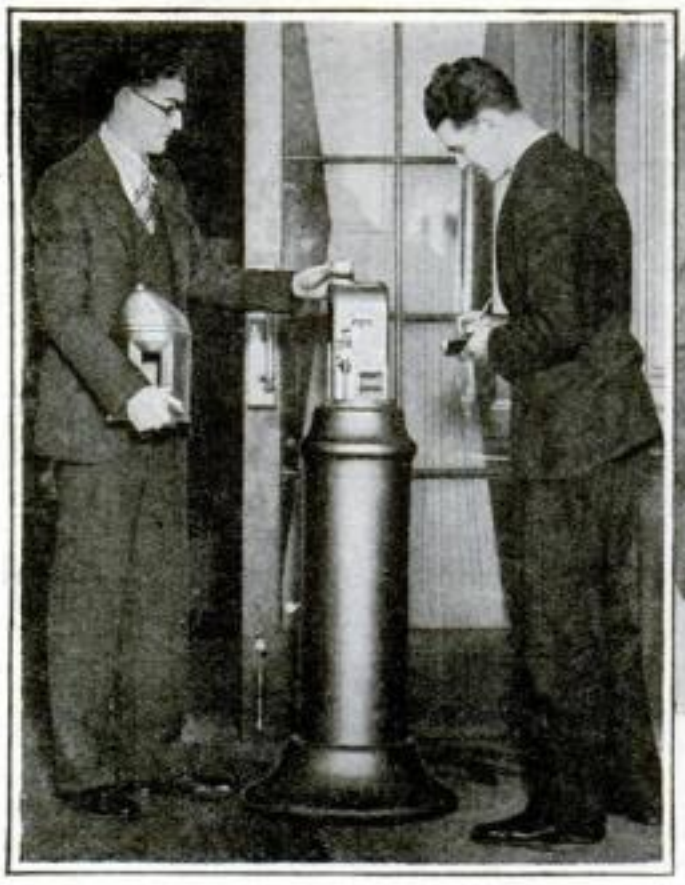
FOR literally hundreds of years, the only method used by European wine growers to accelerate the natural ripening or aging process of wine consisted of drawing the liquid from one cask to another, a system known as "racking."

But a few weeks ago, a French chemist and wine expert reported he had discovered a way of improving both upon Nature and the antiquated methods of the wine growers. He found that, by subjecting cheap new wine to an alternating electric current of 120,000 volts, he could turn it into a "century-old vintage" within about two hours!

The only requirement, he says, is that the wine be of good fundamental quality, explaining that the quick ripening is due to chemical changes in the flavoring oils and other constituents of the wine.

POPULAR SCIENCE MONTHLY will be glad to supply, wherever possible, names and addresses of manufacturers of devices mentioned in this issue.

Machine Counts Audience in Ticketless Theater



Tallying the number of people in the audience, recorded by the mechanical substitute for ticket-takers.

TOKENS have replaced tickets in a theater in Cambridge, Mass. The theater-goer receives a metal disk at the box office instead of a pasteboard ticket in return for his money. At the entrance, he slips his token in the slot of a machine, resembling a pay-as-you-enter street car coin collector. This mechanism keeps a record of the people entering the theater so that the number of vacant seats in the house can be accurately determined at any time, and the total attendance tallied at the end of the show.

If the machines prove to be a success, they may be installed in large moving picture theaters throughout the country.

New Device Makes "Stills" from Home Movies

THE "just right" fleeting expressions on the baby's face, as recorded in your home movie film, now can be recorded in enlarged form for your album. A simple device attached directly to your home movie projector permits you to find the "frame" containing the desired pose and then allows you to project this frame onto ordinary negative film, thus producing a new "still" negative from which any number of prints can be made.

A tapered box fitted with an enlarging lens at the small end and a two and one fourth by three and one fourth film pack adaptor at the large end is slipped on in place of the regular projection lens. A trapdoor in the top of the box allows you to view the film being projected on the film pack slide, which is white. When you strike the frame you want, the projector is stopped, the special shutter fitted to the enlarging lens is closed, the film pack slide is removed, and another pressure on the shutter release makes an exposure of just the right length to insure a good negative on the film.

When the twelve films in the pack have been exposed they are developed and printed in the usual manner.

Albert Wehde, Bertillon expert (second from left) shows how fingerprints may be counterfeited.

How Fingerprints Can Be Counterfeited

THAT it is possible for criminals to counterfeit fingerprints and so divert suspicion from themselves to innocent persons was demonstrated recently by Albert Wehde, a Chicago Bertillon expert.

Before students of Loyola University Law School, in Chicago, he made a fingerprint of one of the students on a piece of paper, then, after treating the print with ink, he transferred it to a special rubber glove, from which he was able to transfer it again to any object in the room.

By another method of counterfeiting, a zinc line cut can be made from an original fingerprint, and from this can be manufactured a rubber stamp which will impress the identifying lines and whorls of the fingerprint. Criminals have been known to attempt the use of such stamps, attached to rubber gloves, to throw the police off their trails by false clues.

Because it has been estimated that not once in ten thousand years will the fingerprints of two people be identical, the Bertillon method of identification has been considered practically infallible, in the past. New methods of detecting counterfeit prints now may have to be devised, Wehde believes.

Although scientific crime detection by means of fingerprints has been a development of only the last half century, recent researches show that the Chinese, as early as 200 B.C., used an impression of the thumb to sign legal and business transactions, knowing that each person has a peculiar thumb print of his own, different from all others.

Attachment for making "stills," showing trapdoor through which projected film is viewed.

Scientific Fishing Party Hunts Sea Mammoth

A HUGE sea-bat of the Pacific, shaped like a pancake and believed to weigh several tons, is one of the prizes sought by a scientific fishing party led by Gifford Pinchot, former governor of Pennsylvania, which will cruise 15,000 miles through tropical waters on a nine-month search for new forms of sea life. The specimen sought by the party is said to be a giant relative of the devilfish. White markings on its black back is one of its distinguishing marks.

William Beebe, noted authority on sea life, is said to have sighted one of the mysterious monsters off the Galapagos Islands, but no specimen has been captured or scientifically classified. A sturdy whale boat is included in the equipment, to allow members of the party to give chase and harpoon one of the huge fish if it is sighted.

Most of the long voyage is to be made under sail, although the ship has a Diesel auxiliary engine. Tanks on board will be filled with live specimens, and laboratories are provided for the work of mounting.

"TURNING the pages of POPULAR SCIENCE MONTHLY is like opening a surprise package," says a reader in Springfield, Ill. "I for one am never disappointed, for I get a real 'kick' out of every new invention and discovery. What amazes me is the vast number of ideas that take form in this magazine each month."

Left: Sorting the diamonds preparatory to setting them in the wax design. Above: Transferring stones from tiara to wax design of bracelet. Right: Removing stones for resetting.

How Jewelers "Set the Stage" for Diamonds

LIKE actors, diamonds have to "rehearse" their places before they become part of a finished piece of jewelry. On a smooth surface of wax, the jeweler, who plays the part of "director," sketches the design of the proposed bracelet or tiara. In the wax he places the diamonds in different positions according to their size and other characteristics. These positions are altered until he thinks each gem shows up to best advantage. The stones are then transferred in the same relationship to the precious metal of their permanent setting.

The photographs above, made in the studio of a Regent Street, London, jeweler, illustrate the process.

In preparing diamonds for jewelry, the stones are first ground by an iron wheel surfaced with diamond dust and emery. Then they are sorted and graded into different groups according to their weight and color. After this they are given "try-outs" on the wax stage.

Because tiaras are not as popular as they once were, jewelers are sometimes called upon to transfer the diamonds in them to other pieces of jewelry. In this work, the same procedure is followed. The gems removed from the tiara are laid out on the wax surface so that the owner can judge the arrangement and indicate whether he desires any changes.

Radium Used to Prevent Rubber Factory Fires

RADIUM, priceless tool of medicine, has a new use. In a rubber factory at Leningrad, in Russia, it prevents fires.

Its remarkable fire-protecting quality is due to the ability of radium to make the air around it a better conductor of electricity. Hitherto sparks of static electricity that jump from rubber fabric passing over the factory rollers have constituted a dangerous fire hazard, since a rubber drying room is filled with inflammable vapors. Now the presence of a small capsule of radium permits electricity to leak slowly and harmlessly from the rollers into the air, instead of accumulating a sufficient charge to produce a fat spark.

Since only one milligram of radium is used the novel method is said to cost only a few dollars. The radium need not be renewed, since it lasts for centuries.

Machine Signs 7,500 Checks an Hour

AN ELECTRICALLY operated machine that signs 7,500 checks an hour, and stacks them in proper order, has been invented to relieve officers of banks and large business organizations from the routine of signing checks by hand. The machine is a miniature offset press which transfers the signatures from a lithographic plate to the paper of the checks.

When the machine is not in use, it is kept locked. Two keys are required to open it. A meter is built into the machine to record the number of checks that run through it. Thus additional checks cannot be signed by the device without detection.

The operator of the mechanical signer places a sheet of four, five, or six checks in the machine and regulates its action by means of a pedal similar to that on a dictating machine. A mirror at the rear shows whether the checks are being signed, cut, and stacked properly.

The operator feeds sheets of blank checks into the machine, which signs them, cuts them apart, and stacks them in order.

WOULD you like to fly? If so, don't miss Larry Brent's vivid story of his experiences in learning to be a pilot. Whether you're interested in flying or not, you'll enjoy his thrilling articles. Turn to page 26.

Small Pieces of Ice Keep a Refrigerator Colder

SEVERAL small pieces of ice are more effective in a refrigerator than a large cake of the same total weight, recent tests at the Popular Science Institute of Standards, New York City, indicate. It was found that lower box temperatures can be maintained by using the small pieces.

C. F. Belshaw, a refrigerator specialist of Detroit, Michigan, recently gave the opinion that it is as unsatisfactory to use ice in large cakes in a home icebox as it would be to burn fifty-pound chunks of coal in a furnace.

This Tree Has No Enemies and No Diseases

A TREE without an enemy is reported by Dr. W. A. Taylor, of the U. S. Department of Agriculture. It is the Japanese ginkgo tree, planted in many parts of the United States. As far as is known, no fungus or insect pest attacks the ginkgo in this country.

In Japan and China, where the tree grows wild, its fruit is valued. Chinese in Washington, D.C., where a driveway leading to the Department of Agriculture buildings is lined with the trees, pick up the fruit that fall from the trees, take it home, and eat the kernels. The nut inside the fruit is palatable, but the odor of the pulp is unpleasant.

Fossils of the ginkgo have been found in rock layers of early geologic times, indicating that it is closely related to the first tree forms on earth.

Floating Deck to Save Lives at Sea

Our artist's dramatic conception of how the proposed life-saving quarter-deck would carry passengers and crew to safety from a sinking steamer. Inset at top shows how the life-deck would be carried.

A QUARTER-DECK that will float away when a vessel sinks has been designed by Duncan Campbell, an English inventor, to serve as a huge lifeboat in carrying passengers to safety. His unique boat within a boat, he believes, would have prevented loss of life in recent shipping disasters.

Installed in a steamship, the detachable quarter-deck will fit snugly into a skeleton iron cradle, its bulkheads conforming to the lines of the ship. Where it rests upon the parent vessel, heavy rubber or other elastic material will be placed to eliminate the possibility of bumping or scraping.

To prevent this unusual lifeboat from sliding sidewise with the roll of the ship, the keel is designed to fit snugly into a groove in the iron cradle. Teeth along the keel fit into sockets in the ship's frame, preventing all lateral movement without hindering the boat from rising and floating off as the vessel sinks.

At the first sign of danger, passengers will take their places in the cabin of the quarter-deck. In case the cabin cannot hold all the passengers and the crew, the latter will ride on the deck above the cabin. Wireless equipment is to be provided to signal vessels the position of the floating life-ship. Provisions are to be stored in the quarter-deck at all times in preparation for an emergency.

Because his invention eliminates the need of lifeboats, Campbell believes his plan will prove the cheapest as well as the most reliable protection for steamship passengers and crews.

Navigation Simplified by Pocket-Sized Tables

SMALL enough to fit in a coat pocket is a new set of simplified navigation tables, prepared by the Navy Department. They enable a ship captain to compute his exact position with no more elaborate equipment than a nautical almanac, a sextant, and a watch. A reading may be taken regardless of where the sun or stars happen to be in the heavens at the moment. Such is the accuracy of the new method on which the tables are based that a ship's position may be calculated quickly, anywhere on earth, with an error in latitude and longitude of less than fifty feet!

A single simplified formula used for solving every problem in the new tables was worked out by Lieut. Commander J. Y. Dreisonstok, U. S. N. Vessels of the U. S. Navy, on trying them out in the Gulf of Panama, reported they were unusually successful.

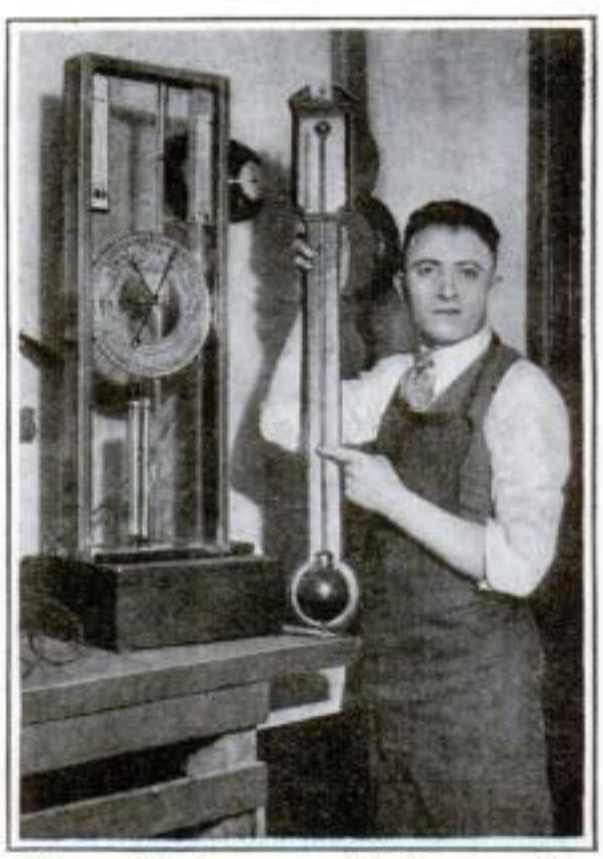
When first published, the tabloid navigating data covered an area from the equator to latitudes of sixty-five degrees, north and south. The Navy's hydrographer, Capt. C. S. Kempff, then prepared tables from sixty-six degrees to the poles for the use of Commander Richard E. Byrd in his Antarctic explorations.

Novel Barometer Flashes Warning of Storms

BY FLASHING on a light and ringing a bell, a new barometer, said to be a hundred times more accurate than the ordinary instrument, warns of changes in the weather. By means of two needle indicators, the inventor, Isaak A. Shermann, of New York City, says he can read the scale to thousandths of an inch. The usual mercury barometer gives readings in tenths of an inch.

Two thermometers, one containing mercury, the other a chemical mixture, are attached to the barometer to insure accurate reading of the temperature. The new instrument is unaffected by the rolling of a ship, the inventor claims, making it especially useful to mariners.

Shermann is working also upon an instrument which he believes will record weather conditions up to six thousand miles away, thus showing airmen the location of high winds and storms before they take off on long-distance flights.



New precision barometer and its inventor. Signal bell and lights warn of weather changes.

Huge "Electric Hen" Will Hatch 20,000 Chicks

ELECTRICITY hatches the chickens, milks the cows, and tends the furnace on a model electric farm established in Ontario, Canada. It was planned to demonstrate the use of almost every type of electrically-operated farm machinery.

One of its most striking features is a giant electric incubator capable of replacing a thousand setting hens. It hatches 20,000 chicks at a time.

Besides farm machinery, all modern home conveniences operated by electricity have been installed. They include vacuum sweepers, electric washers, ironers, fans, and even an electric furnace that operates automatically. Many farms in Ontario are wired for electricity. The current comes from the huge hydro-electric plants at Niagara Falls.

Old Indian the Last of Totem Pole Makers

BELIEVED to be the last totem pole maker in the Pacific Northwest, William Shelton, a Snohomish Indian, still practices his craft near Seattle, Wash. He is continuing, as a means of livelihood, the art which the old men of his tribe taught him when he was young. His totem poles are said to have been sold in all parts of the United States.

The original purpose of the totem pole, containing carved and painted birds or animals and other symbols, was to designate the group of a tribe to which a family belonged. One of the poles was set up outside the entrance of each home.

The Indians living in Alaska and northwestern America reached the highest skill in carving totem poles, although the emblems are believed to have been made by early tribes in practically all localities.

William Shelton, Snohomish Indian totem pole carver, at work on one of his latest creations.

Forty Years a Diver, and Still on the Job

FIGHTING man-eating sharks and entering the hulls of sunken ships are all in the day's work of George Larson, of San Francisco, Calif., who has followed the thrilling profession of deep-sea diving along the Pacific Coast for more than forty years. He is believed to hold the record for continuous service in this hazardous occupation. Most of his work has been at depths between thirty and sixty feet below the waves.

The greatest depth at which useful work has been accomplished by a diver is reported to have been 182 feet.

George Larson, veteran diver, who has braved the deep for 40 years.

Indoor War Game Demands Skill of a General

ALL the strategy of the actual battlefield, it is said, can be used in playing an intricate war game invented by Norman Bel Geddes, of New York, designer of theatrical settings. A huge relief map, showing the topography of the battle scene, forms the basis for the game. Small objects, representing troops, big guns, tanks, observation balloons, and so on, are moved about like chessmen according to rules which the inventor has worked out with the help of Naval and Army officers, a number of whom have become enthusiastic about the game.

It has been proposed that the U. S. Army and Navy use the game to teach war tactics to students at West Point and Annapolis. The photograph shows Mr. Geddes playing the game.

Unearths Mastodon Bones Near San Francisco

INDICATIONS that mastodons, the gigantic prehistoric elephants, inhabited the region of which San Francisco is now the center from two to three million years ago, were found recently by Dr. Eliot Blackwelder, Stanford University geologist.

A mastodon's molar teeth, fragments of the tusk, and portions of ribs and other bones were unearthed twenty-two feet underground near Menlo Park, about twenty-eight miles southeast of San Francisco. Dr. Blackwelder recognized these remains as having belonged to an animal that lived some two to three million years ago. Because a human skull was found beneath the Stanford University campus at about the same depth, the geologist hinted that this relic might be as old as the mastodon bones.

New Cedar Plaster Fights Moths

ESPECIALLY suitable for closets of such irregular construction that cedar lining would be difficult, a new moth-repelling plaster may be applied as a wall coating—both in old homes and new. Actual cedar wood is blended into this novel plaster, which is said to retain its fragrance as long as the wood itself.

All the protection against cloth-eating moths expected of a cedar closet is claimed for the plaster. Its smooth, hard surface may be washed with soap and water without destroying the scent; and it is called dustproof and sanitary.

"Shut Up!" He Commands, and Radio Set Stops

SOMETHING new in radio receiving apparatus is a device invented by Allen B. DuMont, Montclair, N. J., radio amateur, which responds to a handclap or a shout from the other side of the room by turning itself off. As reported to the Amateur Radio Relay League, the secret of the device is a small wooden box that acts as a sounding board, vibrating when a loud sound strikes it. Within it, a copper plate is balanced against a copper wire to form an electric circuit. The slightest vibration breaks the contact between plate and wire, interrupts the circuit, and through a relay turns off the switch of the radio set.

Thus, when the concert he is listening to from his easy chair across the room gives way to an unwanted program, Dumont has but to clap his hands, or speak severely to his receiver, which instantly obeys by "shutting up."

How to Start Your House Right

Shall the Walls Be of Brick, Concrete, Stucco, or Wood? An Expert Helps You Select the Best Materials and Methods of Construction

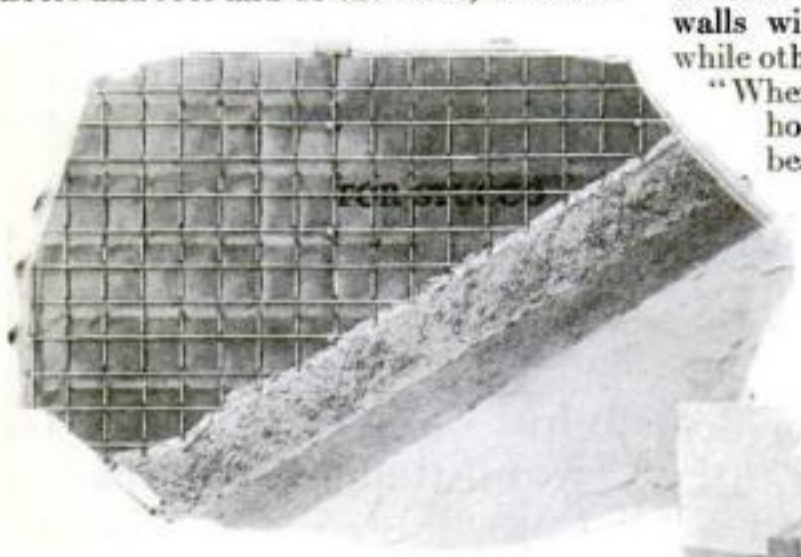
By ROGER B. WHITMAN

WHEN the Kerseys started their venture in house building they were babes in the woods. They had always lived in apartments, and they knew as little about house construction as the average passenger on a steamer knows about navigation.

So, when they moved from the city to a suburban town and someone suggested that they build a house for themselves, their first move was to ask the advice of an expert architect. They showed him a house design, illustrated here, as one that they liked. Naturally, he asked them how they wanted it built, and promptly learned that while they had many ideas on interior decoration and outside appearance, they knew nothing about the practical side. This came out when they said they wanted brick instead of stone for the first story, and he asked whether they wanted solid walls or brick veneer.

"Brick veneer?" they asked. "What do you mean? Isn't a brick wall all brick?"

"No indeed," he answered. "Many houses have wood frames that hold up the floors and roof and do the work, while the brick walls around them are only to keep out the weather. They look as if they were all brick; but inside they are the same as the walls of a wood house."

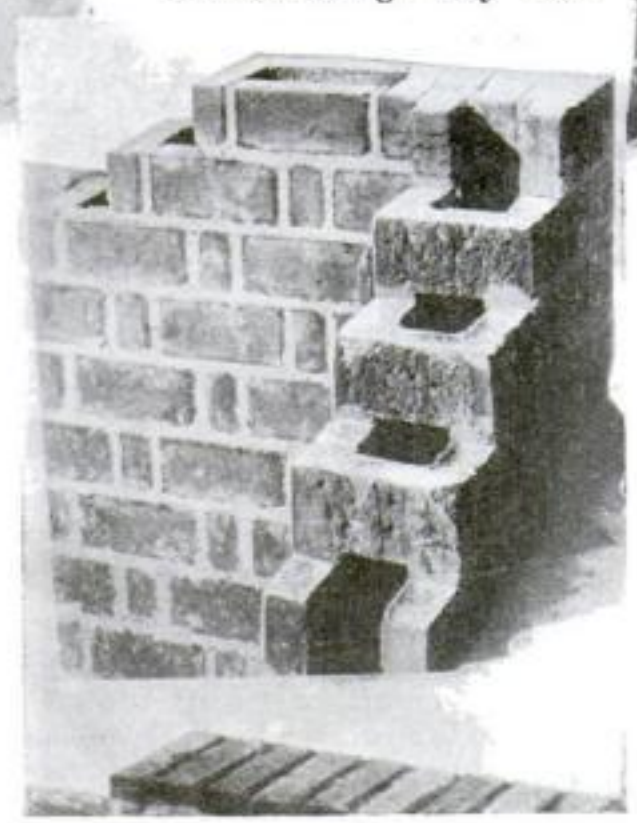


A sturdy form of stucco veneer applied to wide-mesh metal lath backed by building paper.

Mr. and Mrs. Kersey were nobody's fools, and when it dawned on them that there was more to house building than design and finish, they decided they had better hold off until they knew more of what it was all about. The architect approved, and started their training by telling them something about walls.

"First of all," he said, "walls must be strong enough to carry the weight of floors and roof. They must be stiff, too, so that they won't give if a dresser falls over, or shake in a heavy storm. Second, they must keep out the weather; be waterproof and wind-tight. If they are heat proof, as well, so much the better; then heat cannot escape from them in winter or get into them in summer. Some walls will do all these things at once, while others have a separate part for each.

"When the walls are stone, concrete, hollow tile, or brick, the floor beams are built into them and the roof rests on top. But in most houses the weight of the floors and roof is supported on a wood frame. Although the outside walls look as though they were holding everything up, actually they only stiffen the frame and keep out the weather. That jacket around the frame can be made of almost anything—shingles, clapboards, brick, stucco—as long as it is tight against wind and water.



A strong hollow brick wall—two parallel rows bound at intervals by bricks laid crosswise.

"Any kind of a wall can be heat-proofed by building air into it, but it must be dead air; that is, air that is kept from moving and circulating. There can be air spaces in the wall itself, or somewhere in the wall there can be materials that are fibrous or porous and hold air in their cells or between the fibers. Materials of that kind have little strength, and can be used only with something else that carries the weight and does the work."

"But why so many kinds of walls?" asked Mr. Kersey. "Why don't people find out which is best and use that?"

"Each one has its place," answered the architect. "In some parts of the country one material may be cheaper than another, or it may be easier to get carpenters than stone masons. And there is the question of design, for some kinds of houses must be built of certain materials to carry out the architect's conceptions. But cost is the principal thing that people think about. Speaking generally, the frame house is the cheapest to build and the solid wall the most expensive. Almost everyone is limited by the money he can spend, and must hit a happy medium between what he wants and what he can afford."

Laying a wall of concrete blocks. It saves concrete, yet has great strength and stiffness.

He turned to his bookshelves. "Here are some books on building," he said. "Take them home and read the chapters on walls. They'll give you some ideas,

THIS is one of a series of articles giving helpful advice and suggestions on the problems of house building. If, in planning your home, you have some question relating to materials or equipment, write to the Popular Science Institute Building Service, 250 Fourth Avenue, New York City. Advice will be given free.

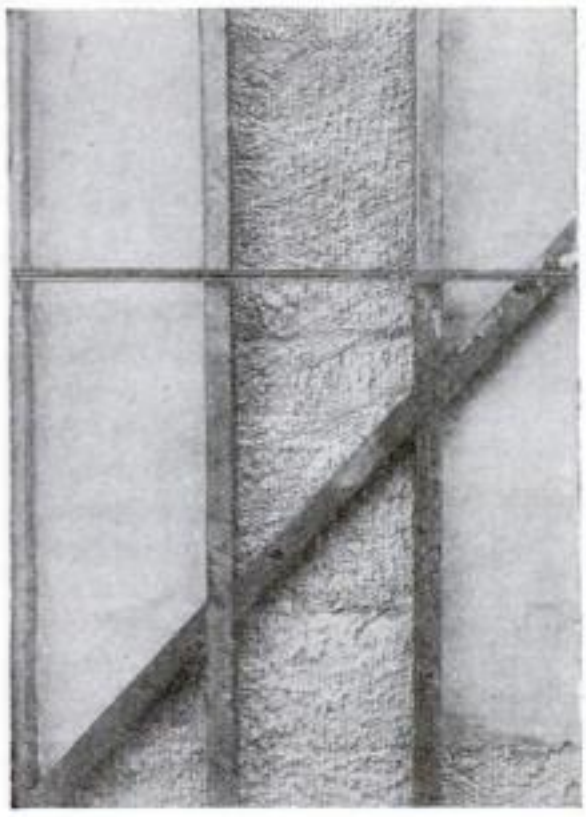
Courtesy The Home Guild of America, Architects

Attractive design chosen by the Kerseys for the house they wanted to build. The walls are of masonry for the first story; clapboard above. To make a good job they decided first to learn the secrets of sound construction.

and we'll have another talk whenever you're ready."

Those books taught the Kerseys more about building than they had thought there was to learn. Being practical minded, they backed their reading by visiting and examining all of the houses under construction within an hour's drive.

OUTSIDE walls, they learned, have their foundations below the frost line and are widened at the base to distribute the weight and to prevent settlement. The foundations can be of stone or brick, but are more generally of concrete because of lower cost. The concrete can be either in blocks or poured to make the foundations one solid mass. Under ordinary conditions, the cellar walls can be waterproofed by a thick swabbing of hot tar on the outside, but if drainage is poor and water likely to collect, there will be need for drainpipes at the footings, or even for inclosing walls and floor in an unbroken jacket of waterproof felt. The thickness of the foundation walls will depend greatly on the material of the upper walls, of course, for a masonry house, for example, weighs more than one of wood.



Back-plastered stucco veneer, with center panel unfinished. The stucco is applied on both sides of metal lath, and no sheathing is necessary.

If the Kerseys were astonished to learn that brick walls of a house often were no more than a veneer, they were astonished still more to discover that even an all-brick wall is not always solid. A solid brick wall is enormously strong, capable of supporting a far greater weight than an ordinary house would put on it. So, to save brick and labor, it is quite usual to make the walls hollow. This can be done in several ways. In one, the bricks are laid on their long edges in two rows, the outer surfaces being eight inches apart, or the length of a brick. At frequent intervals, according to the pattern, the two rows are bound together by bricks laid crosswise, so that while the finished wall is hollow, it loses nothing in stiffness.

Another method is to lay the bricks on their sides in one row and on edge in the next. In this case six courses of one row equal four courses of the other. When the two rows are of equal height they are connected by a course of bricks laid on their sides and crosswise. In these, as in solid walls, spaces are left for the floor beams to be fitted into as the walls reach the proper height.

Spading poured concrete to give wall the greatest possible density and prevent defects.

With strong footings set well below the frost line, as at left, a concrete foundation is hard to beat.

For strength and stiffness there is nothing better than a wall of poured concrete, especially when it is reinforced, for the house then becomes one mass without joints or cracks. In making such walls, forms are placed the proper distance apart and the concrete poured between them, reinforcing bars being inserted wherever necessary. When the concrete hardens the forms are moved up for another pouring, and as the fresh concrete bonds with the old there are no breaks or weak places in the entire wall.

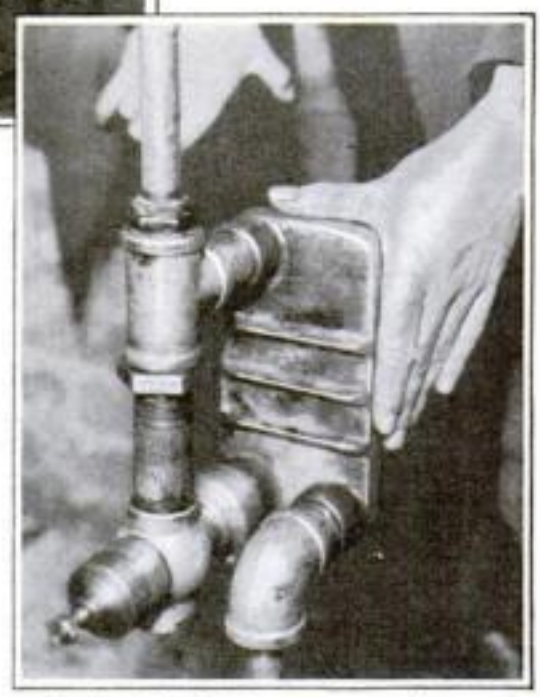
LIKE a brick wall, a wall of poured concrete must be fairly thick to have the needed stiffness, and will then be overstrong for the weight that it must support. To give thickness with less concrete the wall can be built of hollow concrete blocks, and with good mortar and materials will be (Continued on page 155)

Novel Appliances for the Home

The disagreeable task of fishing soiled clothes from a hamper and packing them into a bag for the laundryman is eliminated by this new metal container with bag inclosed. Pulling the bag's drawstring, as pictured at the right, is all the packing required.

The same sort of electric cooling system that provides summer comfort in theaters is now available for small homes through the development of a miniature refrigerating plant, at left. It is said to lower the temperature of an average room ten degrees in thirty minutes. The apparatus, inclosed in a four-foot cabinet, includes air-chilling coil and a fan that circulates the cooled air. Photograph shows both interior and exterior views.

Lift the lid of the laundry container, unsnap a wire frame that holds it together, and the bag of clothes slides out, as below.



An ingenious device to prevent damage from frozen water pipes is a flat chamber, inserted in the pipe, which acts somewhat like an auto radiator. Water, freezing here first, automatically opens a valve that empties all the house pipes.

Snipping with fourteen blades, instead of the customary two, these improved shears make swift work of hedge trimming. Operating somewhat like a mowing machine, the tool clips a path fifteen inches wide, and makes it possible to trim more evenly.

The old-time comfort of a hot brick is brought up-to-date in this new electric foot warmer, which plugs into a wall socket. Its glowing, even heat is especially useful for drying wet feet. It costs only a few cents an hour to operate.

A convenient receptacle for electric cords that connect irons, toasters, and other accessories with the power supply is this small wall cabinet containing a spring reel that pulls the cord out of the way when not in use. When you have finished ironing, simply press a small lever in the wall panel, and the cord vanishes.

After a greasy job on the car or about the house, this nail brush comes in handy; for in the top of the wooden handle is a slab of pumice stone.

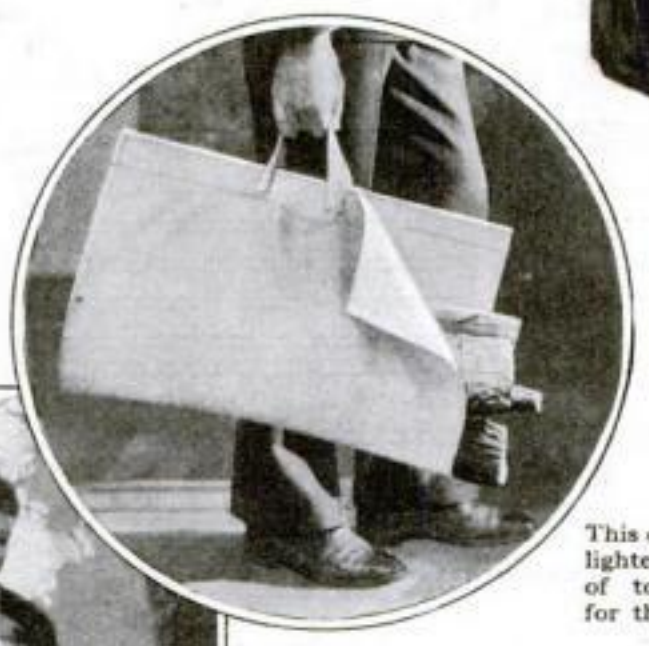
Designed especially for saving space, this attractive new type of dinette folds back into the wall, behind glassed doors that resemble an ordinary entrance. Merely opening the doors and releasing catches that hold the folded table and benches in place is all you have to do to set up the outfit.

Folded, this new piece of kitchen furniture is a convenient stool. Opened, it becomes a stepladder. Rubber treads on the three steps make them proof against skids.

How the dinette looks when folded out of the way. Glass doors backed by curtains give doorway illusion.

35794

You can do the baking, roasting, frying, or toasting right at the table with this little electric stove. The oven has two wire racks and is large enough to take two full-size pies at one time. The stove has a burner plate of standard size with three-heat switch.



This canvas sling lightens the job of toting wood for the fireplace.

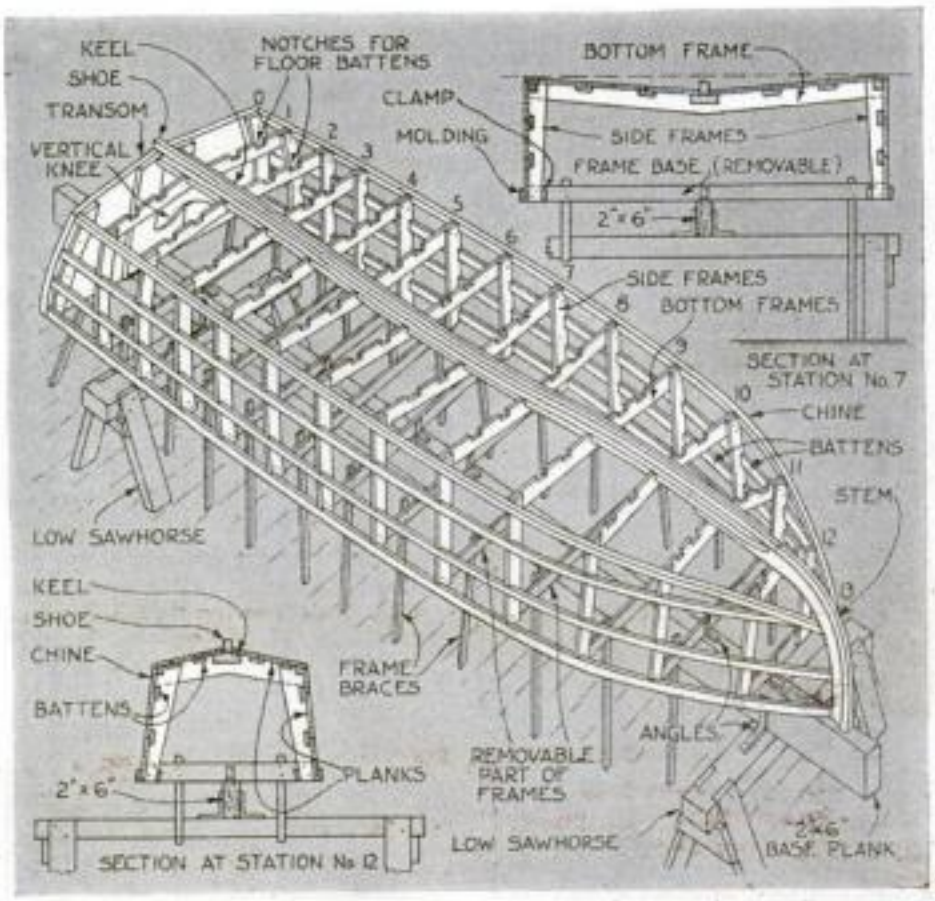
The clothespins are always right at your elbow in this convenient canvas container. It rests on a spiked metal rod which is stuck into the ground.

Turning the dial on the electric refrigerator attachment below regulates the icebox's temperature. It permits use of six different freezing speeds.

This folding bridge table, with its own rack, solves the problem of what to do with the table when not in use. Folded and fitted into a special rack, it serves as a fire screen. When the bridge party is on, down it comes for the evening's play. A locking device holds the table top in the rack.

Making a Family Motor Boat

By
NEWCOMB LEONARDE



How the framework is constructed in an inverted position. The permanent members appear in white to distinguish them from the temporary braces.

DESIGNED so that the amateur can build it easily, the outboard motor boat illustrated on the opposite page is in all respects a 1929 model. She is a small, comfortable, safe, yet reasonably fast family boat for a short trip down the river or along the shore on a summer's day.

With present-day outboard motors this design will give entire satisfaction. Indeed, it represents my conception of a family boat based upon the experience of twelve years with outboard motors.

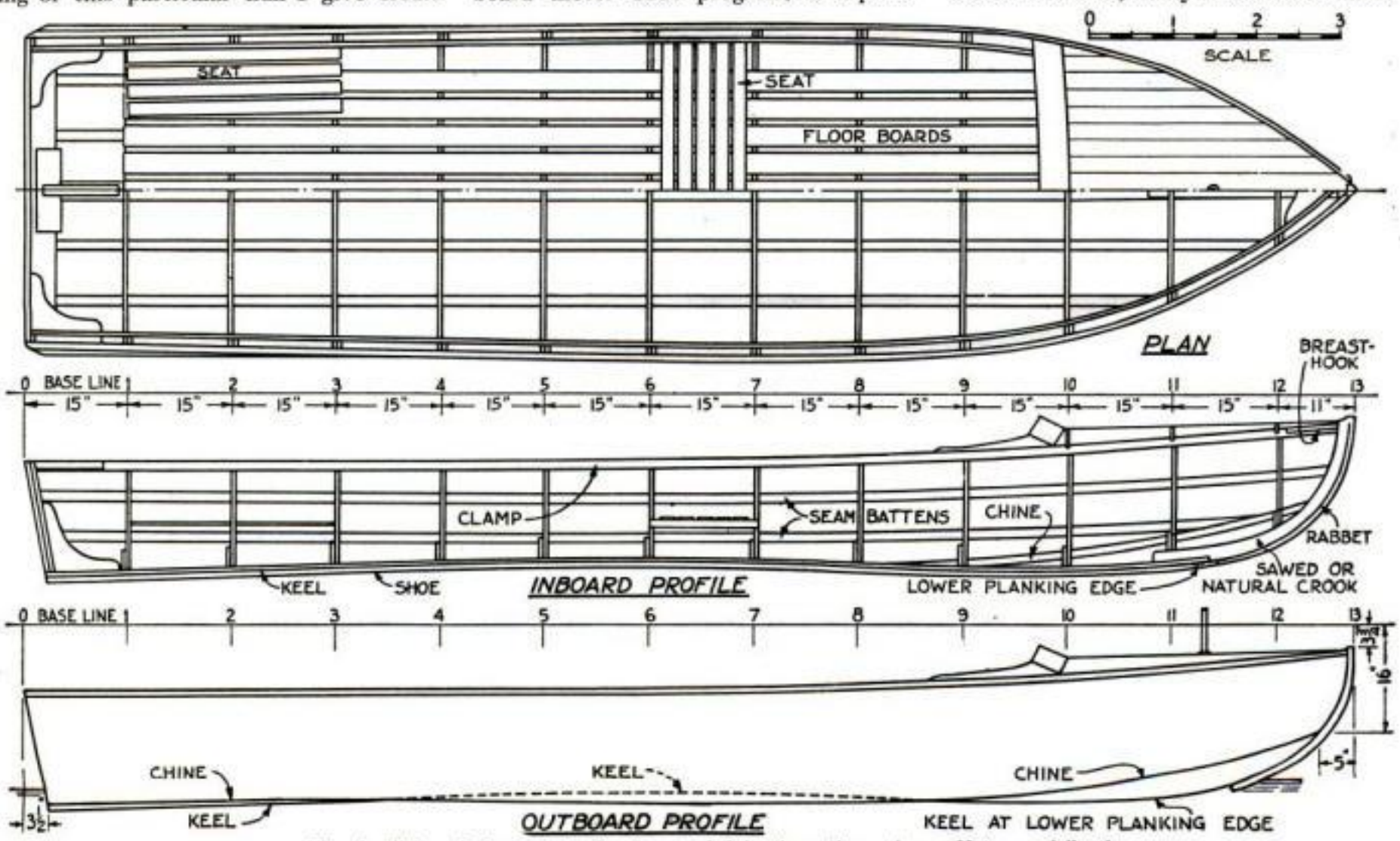
The unmistakable movement of the family man to the water for recreation was shown in last season's use of outboard boats. That was the real development of the year, and as a result the number of new boats to be built this year for purposes other than racing has been estimated as high as 50,000.

Credit for developing this type of motor boat must go to a New York enthusiast who has no superior as an authority on outboards. For the designing of this particular hull I give credit to the technical editor of one of the motor boat magazines—an eminent naval architect. They are the authorities behind my story, for, knowing from my own long experience that boat building is quite a task for the amateur, I have played safe with a well-tested design—one generally termed the "biplane."

For those who have not followed outboard motor boat progress, a biplane boat, to quote a technical description of it, "runs upon two planes, each with a V section. One of these planes is forward, about one quarter length abaft the stem, and the other is at the stern of the boat. Between these two planes and approximately amidships, the bottom becomes an inverted V. The outboard profile and sections show that while the keel is normally below the chine forward and aft it rises above the chine amidships, forming an inverted V or concavity. When planing, the boat rides upon the forward and after plane, the pressure created at the forward plane being relieved by the rise in the bottom immediately abaft this plane."

It will be noted from the drawings that she is a good looking boat. She has the nautical appearance so necessary if one is to keep away from the cigar box type, and she can be "dressed up" just as much as the builder chooses.

Personally, I am not overly enthusiastic about varnished boats, for it is something of a task to keep a varnished surface in satisfactory condition without putting a great deal of time on it that might better be spent in the use of the craft. However, many men like to finish



The simplicity of the construction is revealed in these three views. Note especially the line of the keel—a typical "biplane" feature—and its relation to the outboard profile.

It Is Surprisingly Easy to Construct a Safe, Light, Speedy Hull for Use with an Outboard Power Plant

SIMPLICITY of construction, good lines, comfort, and a high degree of safety are the outstanding characteristics of this fast 16-ft. motor boat.

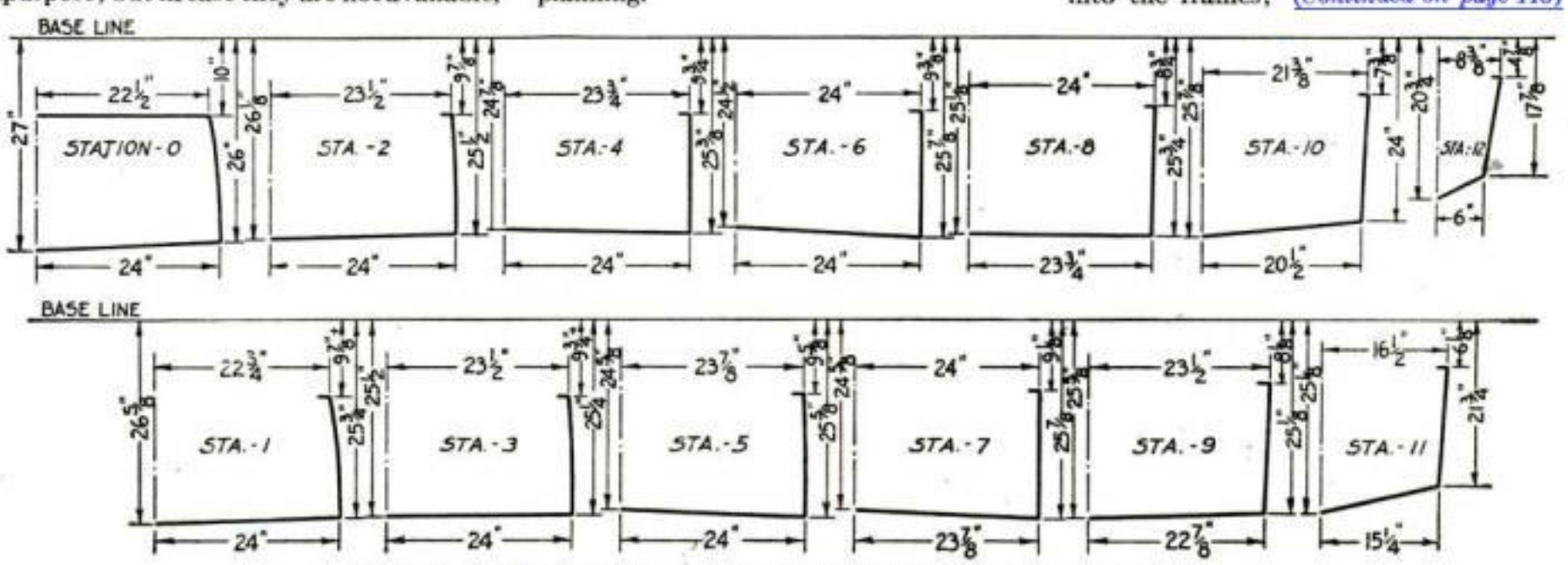
their handiwork in varnish, and they may do so in this case. It is merely a question of using mahogany for a bright finish and white cedar if the hull is to be painted.

Study carefully the plans as well as the specifications on page 118. From the latter get out your own bill of materials. Note that the boat is to be nearly 16 ft. long, which means that you can get the keel out of a 16-ft. piece of ⅞ by 2¾ in. oak or spruce. Remember that the customary term for thickness among boat builders is "molded," and that "sided" means width. Take your bill of materials to your local lumberyard and get a figure on the material item by item, cut as nearly to size as possible. Also stick to the kinds of wood specified, if possible, as they are the best for the purpose; but in case they are not available, use the next best substitute. Emphatically, do not take any kiln dried lumber. It is not good for boat work.

Usually the first step in boat building is to lay down the plans full size, so that the lines may be "faired" up. This is done from a table of offsets supplied with the drawings; but in this case I have had simplicity in mind and so have supplied dimensions for each of the frames, which in the seam-batten construction used here are also the molds over which the boat is built. These dimensions are all half breadths from the center line; and the heights of the keel, chine, and sheer plank are given from the base line. In getting out the frames, deduct the planking thickness, which is 5/16 in., from the dimensions given. Boat dimensions are always given to the outside of the planking.

It is always best to build small boats bottom side up, at about hip height so as to make the work less tiresome. My method is to use two low sawhorses, on which I set a 2 by 6 in. straight plank on edge, leveling it carefully. The plank and horses are fastened together firmly and the horses are fixed to the floor. I then lay out the stations on the top edge of this plank, letting the top edge be the base line from which all sheer-plank and keel heights are measured.

Before doing this, it may be well to lay down all the stations (frames) on heavy paper; then you can lay the frame members down on the drawings for accurately fastening the sides and bottom sections. On the stations of the full size drawing you can draw in the keel section and thus determine the size of the notch to be cut into the frames; (*Continued on page 118*)



Half sections giving the half breadth measurements and the distances from the base line. As customary in boat drawings, all dimensions are to the outside of the planking.

How to Build a Tavern Table

Measured Drawings and Directions to Aid You in Making an Exact Copy of a Rare and Valuable Colonial Antique

This type of table, originally used in taverns, is highly prized by collectors of Early American antiques for its charm and general utility.

By FREDERICK J. BRYANT

TAVERN tables were among the earliest types developed in this country and were very common before the Revolutionary War. The few to be found today are highly prized by their owners. They were made with round, oval, or square tops and varied from the size of this one to a length of 4 ft. or more.

Reproductions are popular because a table of this type blends well with almost any style of modern furniture. We see them used as side tables and radio tables and for holding smoking sets; in fact, everywhere in the home.

This table is made of maple, except for the one-piece top, which is pine. It has seen a lot of hard use and has been painted a number of times. At present it is finished in its natural color and has two coats of white shellac and one coat of wax.

Because screws were unknown when this table was made, the joints are reinforced with wooden pins or dowels. Even the top is held down with pegs; and no metal is to be found in its construction.

A copy can be made of almost any kind of wood, and the finish is entirely a matter of choice. To get the best results in turning the legs, it may be advisable first to lay out the shape full size on paper. Two sections of each leg are left square. Sandpaper the turned work in the lathe as smooth as possible.

The stretchers at the bottom and the rails under the top are mortised and tenoned into the legs. The stretchers are as thick as the legs, but the rails are only ⅞ in. thick. However, all the rails are flush with the outside of the table legs.

To find the correct angle in cutting the rails and stretchers, lay out a full size drawing of the end and side views of the table. Don't forget to allow about ¾ in. for the tenons on each end.

After all your joints are made, glue the end frames together. Wipe off the surplus glue and put the frames aside until the glue hardens. In the meantime you can work on the table top.

No doubt you will have to use two or more pieces for the top; a board 19¾ in. wide isn't always available. Three 7-in. boards are suggested, as this will allow enough extra stock to be planed down to the finished measurements.

An easy way to lay out the oval shape is to cut out a heavy paper pattern 9⅞ in. wide and 13⅜ in. long. Rule this paper off into 2-in. squares, starting from the lower right-hand corner. Now refer to the crosslines shown on the drawing and point off your outline on the paper pattern. Connect the pencil points with an easy, graceful curve and cut the design with a pair of shears.

Place your pattern on the table top, which should measure exactly 19¾ by 26⅜ in. Have the pattern touch one end and one side and mark the outline. Repeat this on the other three corners. You are now ready to remove the extra wood and spokeshave down to the line. The upper edge of the top should be rounded over and sandpapered.

Glue the end frames, the 12-in. side rails, and the 14½-in. stretchers together. Proceed as before and test your work with a steel square to be sure the frame is true.

The top can be fastened down with angle irons on the underside or pegged into place as in the original table. Whether you dowel all your joints and the top depends upon how closely you wish to copy the original table.

As the legs do not stand in a vertical position, each one will have to be filed or sawed a little at the bottom. A coarse wood rasp will serve very well, and a level bench, table, or floor will do to test the work on.

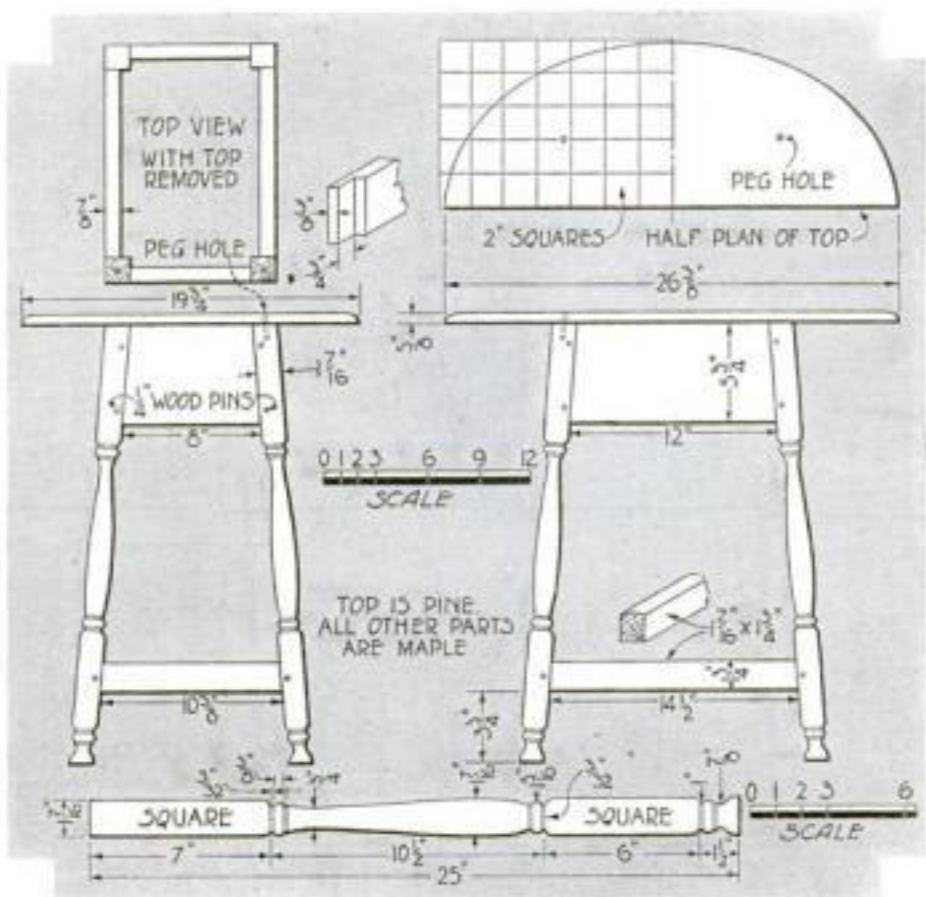
The finish depends upon the kind of wood from which the table is made. If you select mahogany, walnut, or gumwood, an oil stain, filler, and varnish may be used. Colored enamels or brushing lacquers will also give good results.

You will find the work of constructing this unusually fine tavern table easier if you send for our Blueprint No. 105 with larger drawings. The cost is 25 cents.

The Materials Needed

No. Pcs.	T.	W.	L.	Parts
1	⅝	19¾	26⅜	Top
4	1 7/16	1 7/16	25	Legs
2	1 7/16	1¾	16	Long stretchers
2	1 7/16	1¾	11⅞	Short stretchers
2	⅞	5¾	13½	Long rails
2	⅞	5¾	9½	Short rails

All dimensions are in inches. The top on the original table is pine. The other stock is maple. Each dowel is about ¼ in. in diameter, and the ends of the pegs are almost square.

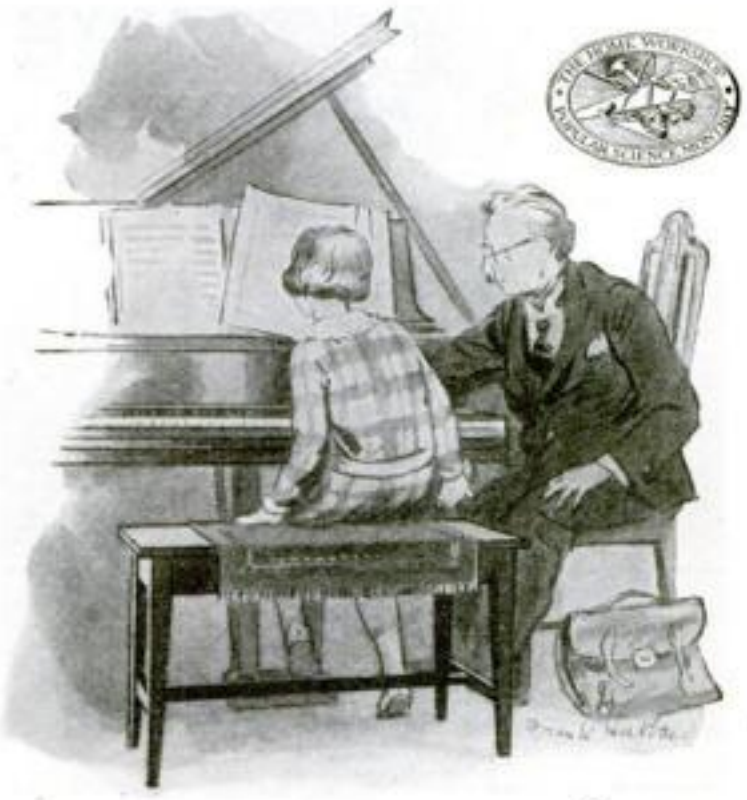


Drawings of a tavern table based on careful measurements made by Mr. Bryant, who is the supervisor of manual arts at Auburn, Maine.

Constructing a Piano Bench

A Variety of Designs, Both Plain and Ornate—Hints on Shaping the Legs

By CHARLES A. KING



A neat, strong, easily made piano bench which contains a roomy storage compartment for music underneath the seat.

"HOW can I make a combination piano bench and music case?" is a question regularly asked by readers of POPULAR SCIENCE MONTHLY who have home workshops.

To aid those who wish to undertake this always satisfactory and not particularly difficult project, several designs are suggested in the drawings below. The main difference in the various types lies in the shape of the legs. Use the design which will harmonize best with your piano; although, of course, a bench with plain legs will be in good taste for use with practically any instrument.

To make the simplest of the benches illustrated—that for which complete side and end views are given—prepare four legs 1¾ by 1¾ by 18⅝ in. and taper them as shown on the inside faces from a point 4½ in. from the top to the bottom, where they are 1 in. square.

Make two side rails ⅞ by 3¾ by 36½ in., and two end rails ⅞ by 3¾ by 10½ in. Rabbet the rails to receive the ½ in. thick bottom and bore for dowel joints. Smooth, sandpaper, and assemble legs and rails. Fit the bottom and fasten it securely in place with 1¼-in. No. 16 brads.

Glue up a well-selected piece for the seat ⅞ by 16 by 42 in.; or if you prefer you may use plywood, provided you can obtain it as thick as ¾ in. In using glued-up stock, plane and sandpaper the underside and fit two cleats ⅜ by 2½ by 11 in. as at *C* and fasten them with 1-in. No. 8 screws.

Plane the tops of rails and legs to fit the seat and hang it with 3 in. wide brass butt hinges as at *B*. The hinge must project back far enough to allow the top to be opened fully without binding on the legs, and you may therefore fit a piece ¼ by 1 by 36½ in. as at *D*, if you wish, to bring the top of the hinge rail flush with the outside of the back legs.

Smooth and sandpaper the seat, and the bench will be ready for finishing.

If music is not to be kept in the top, the top rails may be made narrower and the bottom omitted. Bottom rails and a stretcher may be fitted as shown at *E*, if desired.

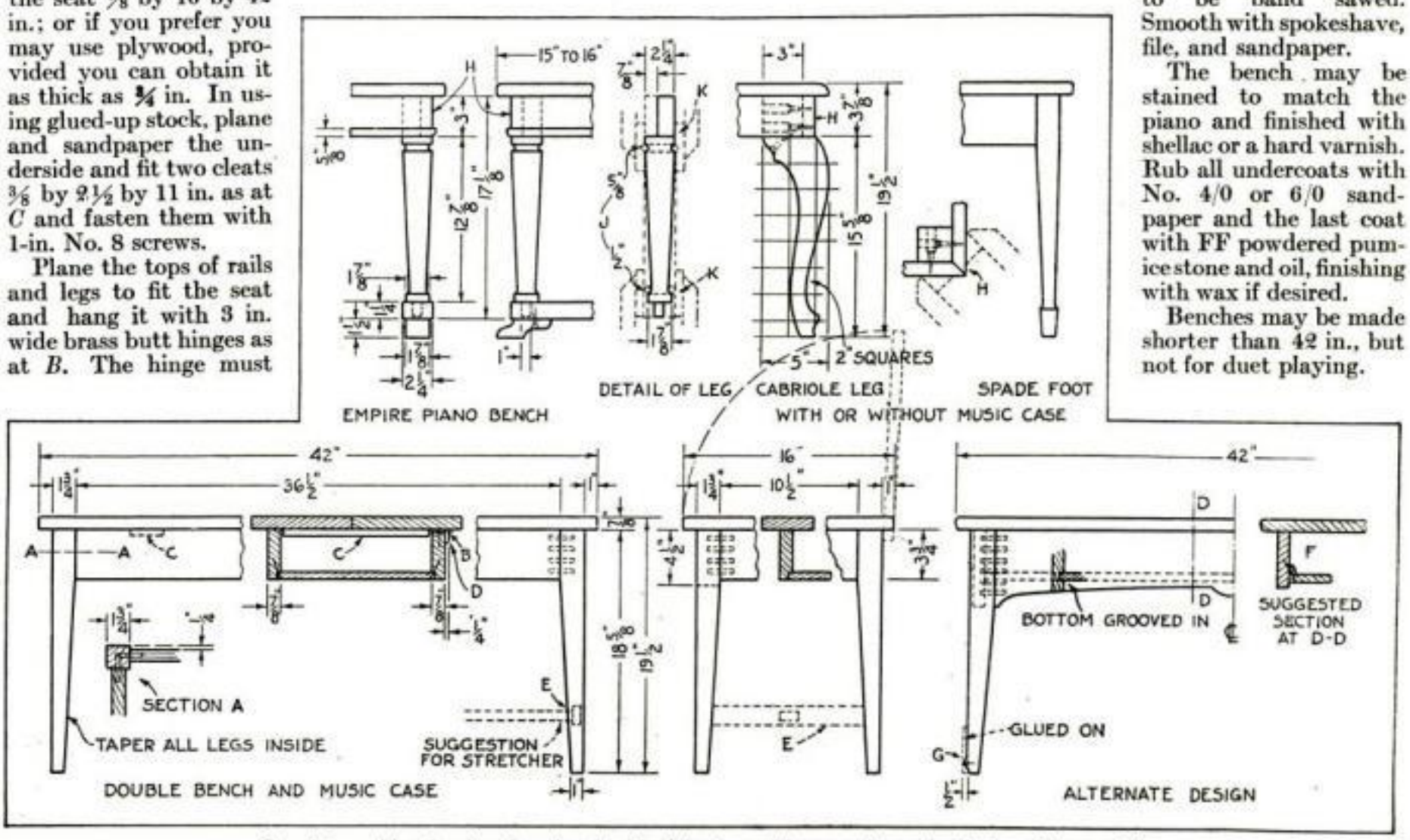
The bench may be elaborated by making the top rails 6 in. wide and sawing a design upon the bottom of each. The bottom may be fitted into a groove, or fitted square after the legs are assembled as at *F*. Feet may be suggested as at *G* by gluing on pieces of ½-in. wood and working them to a pleasing shape. The spade foot leg may be used as an alternate design.

The Empire bench and the bench with cabriole legs are made with mitered rails, fitted and glued together as at *H* and strengthened with screws. The Empire legs may be made from 2¼ in. square wood and the semicircular holes *J* bored with sharp, clean cutting auger bits; each hole should be square and parallel with its related surfaces. Pieces *K*, held in place with hand screws, will help in boring these holes.

The cabriole legs may be cut from 5 in. square stock. Make a pasteboard pattern, mark each of the squares on adjacent sides, and take the wood to a mill to be band sawed. Smooth with spokeshave, file, and sandpaper.

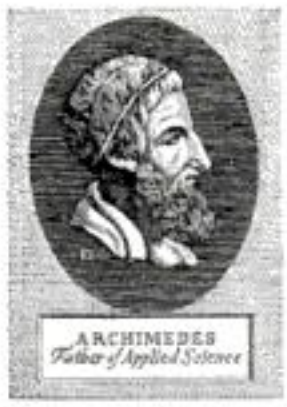
The bench may be stained to match the piano and finished with shellac or a hard varnish. Rub all undercoats with No. 4/0 or 6/0 sandpaper and the last coat with FF powdered pumice stone and oil, finishing with wax if desired.

Benches may be made shorter than 42 in., but not for duet playing.



Complete working drawings for a bench with plain, tapered legs; an alternative design with gracefully shaped rails and feet; and (above) an Empire style bench, a cabriole leg, and a leg with a spade foot.

Popular Science MONTHLY



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How to Get Rich

A POPULAR lecturer says that the modern automobile has about reached the limit of development. Is he correct? Not by a long shot! True, hand-cranking and frequent roadside repairs are gone forever. Compared with its progenitors, the modern automobile is a marvelous piece of mechanism, but there are countless ways in which it can be improved.

The puncture and blow-out, for instance, are still to be banished. Nobody yet has invented an effective tire immune to such troubles. Driving is marred by the necessity for frequent operation of the clutch and gear-shift lever. Discover a way to eliminate these apparently necessary evils and your fortune is made.

The modern auto develops in power at the rear wheels from five to fifteen percent of the actual energy contained in the gasoline. Theoretically we ought to get better than 200 miles to the gallon instead of the paltry ten to twenty at present. Finding out just why we don't, and showing us how we can, is another way to get rich.

Then it takes from one to two tons of automobile to transport a man weighing 150 pounds. Nine tenths of the energy we are able to develop out of our gasoline must be used to transport useless weight. Opportunity there.

At least a few of these quite obvious deficiencies ought to be eliminated before anyone is entitled to say that the day of the inventor is over as far as the automobile is concerned.

The "Inside Dope" on Flying

AMERICA'S leading authorities voice their views on the future of aviation elsewhere in this issue.

One sees, in the very near future, thirty-hour trans-Atlantic airplane service, using ocean landing platforms. Another tells of airships that make even the Navy's new 6,500,000-cubic-foot twins seem pygmies by comparison. Planes whizzing through thin air miles above us at 400 and 500 miles an hour are discussed gravely, and, as a sole discordant note, one man sees the hope of future aviation only in a type of flying machine radically different from anything now known.

From such a group, widely differing opinions may be expected, and are healthful. The important thing is the significant agreement of most of them on immediate developments. Monster planes equipped with every luxury and comfort are to be used widely. Amphibian machines, able to land either on an airport's runway or on a harbor or river, will be used more frequently. And air travelers will have greater safety through the conquest of fog.

No buncombe about these men, thoughtful students of a serious business.

A Road to Wedded Bliss

IN A marital mix-up which reached the courts in New York, the husband submitted the following letter in evidence, asserting it had been sent him by his wife:

"Here's my New Year's greeting to you. When the following necessities have been accomplished I shall try to show you the respect you are always looking for.

"1. Make a ladder to reach the attic.
"2. Make screens and get busy soon.
"3. Buy me a wash pole so that I do not have to be disgraced in the neighborhood.
"4. Attach a bell to the front door and save the expense of a possible broken window.
"5. Make me a closet under the cellar stairs, to protect my food from dirt and insects.
"6. Make the trellis to hold the rose vine.
"7. Encase the cellar stairs.
"8. Box the front stoop.
"9. Make flower boxes.
"10. Make coal bin.
"11. Make closet for paints.
"12. Clean desk.
"13. Make storm windows."

Perhaps if that husband had been a reader of POPULAR SCIENCE MONTHLY, quarrels might have been averted.

Edison's Clock

A CLOCK that never told time is a prized exhibit of the Edison collection at Henry Ford's museum in Dearborn, Michigan. The face is without hands or numerals, the cross section of a small log. For years it stood over Mr. Edison's fireplace, a silent symbol of a great idea. He placed it there to remind him that the value of work is measured by results and not by hours.

One of the amazing things about this man, who has created vast industries from the resources of his brain, is that he has kept his feet on the ground. Others have attributed his greatness to intangible "genius." Edison, knowing each step he has taken, attributes it to hard work. He has always answered laudatory visitors with his famous epigram, "Inspiration is nine tenths perspiration." While others watched the clock he watched results. *His* clock had no hands.

They Are Saying—

"THE sun is just about as ordinary a star as one could find."—Prof. A. S. Eddington, Cambridge University astronomer.

"Architects are constructing cities which are of impressive beauty but totally unfit for the proper breeding of human beings."—Dr. Alexis Carrel, Rockefeller Institute for Medical Research.

"Eventually we may be able to synthesize the firefly's oil and produce living light."—Dr. E. Newton Harvey, Princeton physiologist.

"There's nothing wrong with aviation. I tried to learn everything overnight."—Fred Stone, actor, recovering from a crash.

"In general, almost anything is learnable at any time up to fifty."—Dr. Edward L. Thorndike, Columbia psychologist.

"Airplanes are a valuable auxiliary to the railroads. They can cut corners and fly over obstructions."—Elisha Lee, Vice-President, Pennsylvania Railroad.

"Workers need two weeks' vacation in winter."—William F. Green, President, American Federation of Labor.

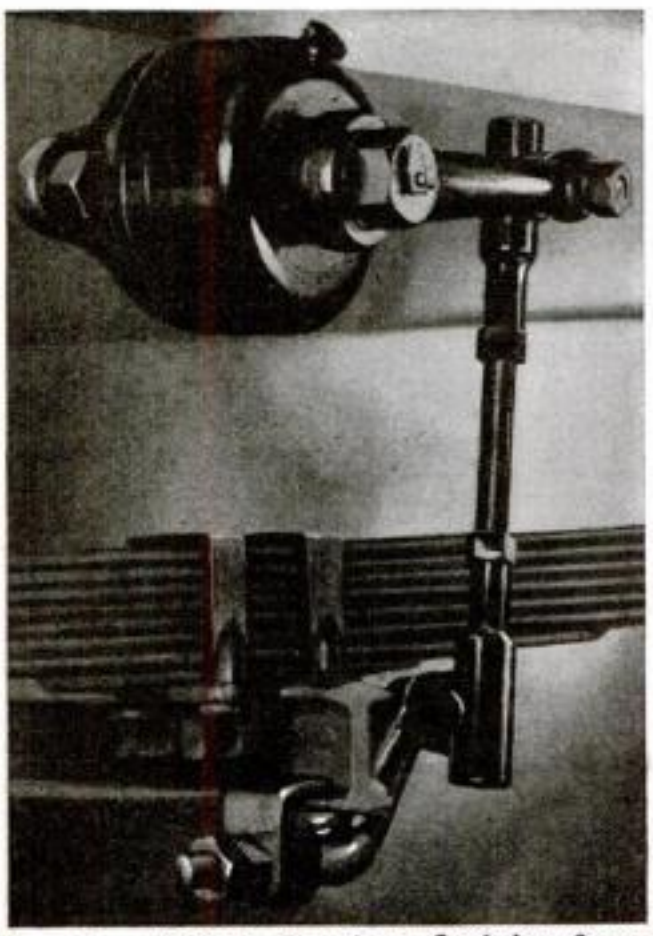
"The devotee of art who looks down from his superior height upon the products of this machine-made age as things unworthy of his attention has no useful purpose to serve in modern life."—J. M. Hewlett, First Vice President, American Institute of Architects.

"The day of the 'flivver' plane is pretty close."—Henry Ford.

"I disagree with the notion that most people overeat and that what a person eats has much to do with how long he lives."—Dr. Solomon Strouse, University of Chicago.

and they learned about HYDRAULICS from

HOUDAILLE



The engineers of Lincoln, Pierce-Arrow, Cunningham, Stearns-Knight, Jordan, Ford, Nash Advanced Six, Chrysler Imperial, Studebaker President, Graham-Paige and 33 European cars have adopted Houdaille Shock Absorbers as standard equipment *on merit*.

THE car you will drive tomorrow is on the drafting boards of automobile engineering departments now. It will be engineered on hydraulic shock absorbers . . . cushions of liquid which absorb the upward and downward thrust and give the smoothest ride over the roughest roads to anywhere.

The adjective *hydraulic* as applied to a shock absorber does not necessarily indicate temporary or permanent riding comfort. Houdaille hydraulic double acting shock absorbers have earned the recognition of eminent automotive engineers as the world's greatest shock absorbers because . . .

1 Their double or balanced piston assures supreme riding comfort for years by eliminating the wear ordinarily caused by side thrust.

2 Their patented reservoir ends the need for trying to make "packing" hold the fluid against high working pressures.

3 Their patented air vents make them *truly hydraulic* by allowing air and gases to escape from the working chambers.

4 Their unusual strength makes safety valves unnecessary . . . they give greatest resistance on roughest roads.

5 Their simple adjustment makes them easily suited to each individual car.

During 27 years of *pioneering*, the industry has learned about hydraulics from Houdaille.

Your Car Dealer can Supply Houdailles.

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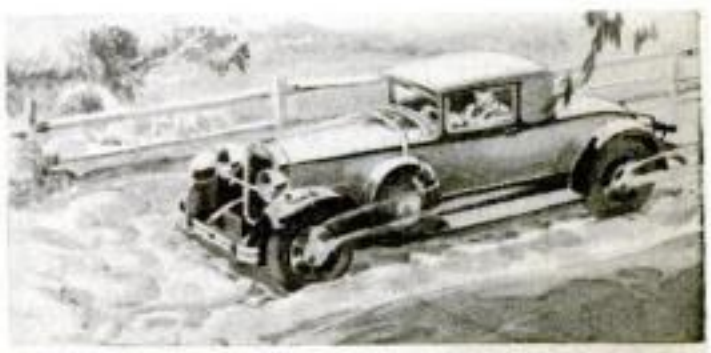
HOUDAILLE

HYDRAULIC DOUBLE ACTING

SHOCK ABSORBERS



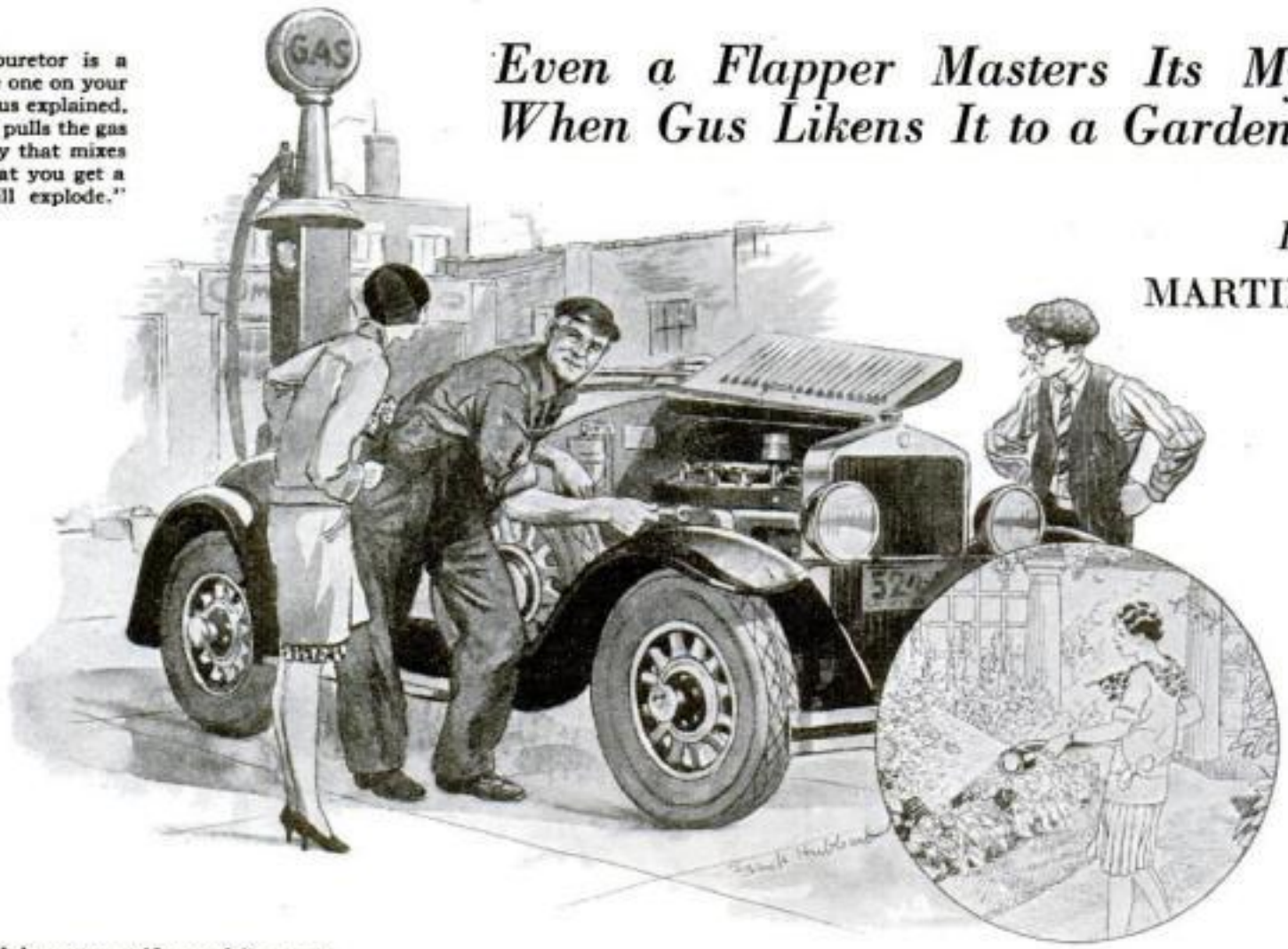
The Smoothest Ride over the Roughest Roads to Anywhere

Do You Know Your Carburetor?

"Inside the carburetor is a little pipe like the one on your garden spray," Gus explained. "Air rushing past pulls the gas out in a fine spray that mixes with the air so that you get a mixture that will explode."

Even a Flapper Masters Its Mysteries When Gus Likens It to a Garden Spray

By
MARTIN BUNN



"HOW is your wife making out driving the car these days?" Gus Wilson, veteran mechanic of the Model Garage, asked his partner.

Joe Clark, bookkeeping member of the firm, laughed disgustedly. "That woman will never learn anything," he growled. "Why is it so hard to teach 'em about cars?"

"Maybe you haven't found the secret, yet," suggested Gus.

"What secret?" Joe asked curiously.

"Well," Gus replied with a twinkle in his eye, "it's the same as teaching tricks to a dog—'first you've got to know more than the dog!'"

"You insulting son-of-a-gun!" grinned Joe as he threw a grimy piece of waste which just missed his partner's head.

"Seriously, though," said Gus, "most people don't know how to explain things about a car to a woman. Now, if I had to do it—"

"Oo—ee! Mr. Wilson!" a lilting feminine voice interrupted Gus's sage remarks.

Joe looked out, and turned to his partner with a sly smile.

"It's Judge Bond's daughter," he reported. "She has a brand-new roadster. Do your stuff now if you know so much about teaching the flappers!"

Marianne Bond was bubbling over with excitement when she entered the garage. "What do you think of it?" she demanded, indicating her new car. "Daddy just gave it to me and I thought I'd ask you to tell me all about how it works so if anything went wrong I'd know what to do."

"That's rather a large order, young woman," Gus smiled, while Joe almost choked stifling a guffaw.

Gus stood in thoughtful silence for a moment while Marianne surveyed him expectantly.

"You know what the carburetor is, of course?" the veteran mechanic asked suddenly.

"Why, yes, of course," responded the girl brightly. "Hasn't that got something to do with putting gasoline in the motor?"

"Something," admitted Gus gravely. "By the way," he added after a moment, "didn't I see you spraying some plants in your garden the other day?"

"Yes—rose bushes," replied Marianne, puzzled by the apparent irrelevance of the question.

"Know how the spray works?" Gus asked.

"Surely, Mr. Wilson. The air just rushes out the end of the pipe so fast it sucks the liquid out of the little pipe as it goes by. But what has that got to do with carburetors?"

"The carburetor works the same way," Gus explained. "Inside the carburetor is a little pipe like the one on your spray, and when the air rushes past it pulls the gas out in a fine spray that mixes with the air so you get a mixture that will explode when a spark hits it.

"YOU know what happens to the garden spray when you have it too full?" Gus questioned.

"You get an awful thick spray," Marianne replied.

"Same thing with the carburetor," Gus stated. "If you open the adjustment too far you let the spray get so thick it doesn't explode right. When the garden spray is nearly empty you have to pump harder to get any spray at all. It's the same in the carburetor. If you close the adjustment too far, you get a thin mixture that won't burn."

"Why that's just too simple for anything," exclaimed Marianne. "Is that all there is to the carburetor?"

"That's all there would be if the motor always ran at the (Continued on page 147)

Ask Gus—He Knows

"THE fellow who's always swilling patent medicines to cure imaginary aches and pains," says Gus Wilson, "is the same bird who gets stuck for all the phoney auto cure-alls. First he puts pink pills in his gasoline to get that snappy pick-up which he had already if he knew how to handle his gears. Then he puts in special spark plugs warranted to give him at least twenty percent more power and never to foul. He doesn't get the extra power and the plugs foul, too, if he puts them in a motor that's pumping oil. After that he puts some special dope in his radiator to make the motor cool right. The motor'll cool anyhow if the cooling system's in good condition, and if it isn't, the dope won't help any. Then he usually falls for the magic goo that prevents punctures. It works fine for a while, but when he gets a blow-out, he generally goes home—smelling wors'n if he run over a couple of skunks."

(Portrait by Morrall)

Look for this mark on every Radiotron

RAY H. MANSON

Chief Engineer, Stromberg Carlson Telephone Mfg. Co., says:

"Experiment with every type of vacuum tube has convinced us of the superiority of RCA Radiotrons. We not only use them for testing the performance of Stromberg Carlson instruments, but recommend them for use in all of our sets."

Ray H. Manson

When you purchase a quality receiving set be sure it is equipped with genuine RCA Radiotrons. If you will replace all of the tubes in your set with RCA Radiotrons once a year at least, you will get the finest reception the instrument affords.

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Building an Electric Motor

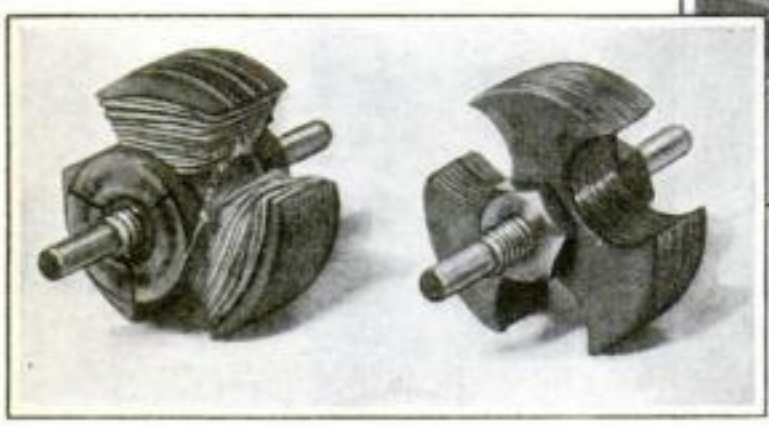
A Design for Schoolboys Which Gives Practice in Twenty-Four Tool and Machine Operations

By S. L. COOVER

3575 8

WE HAVE been building electric motors in our school shops for eight years and the particular model illustrated for three years. It is the result of extensive study and experimental work with more than 1,000 eighth-grade boys.

Besides being a very interesting project for a boy, the motor is simple in design, easily made, cheap (all the materials used cost less than one dollar a motor), and useful. Furthermore, it gives a boy a chance to work with thirteen different materials, practice twenty-four tool processes and machine operations, and acquire some first-hand information about electrical circuits, magnetism, insulation, and other electrical phenomena. The motor is intended for battery operation and is run most efficiently by a 6-volt storage battery.



Small battery-operated motor as built by eighth-grade boys. At the left—an unwound armature and a complete armature.

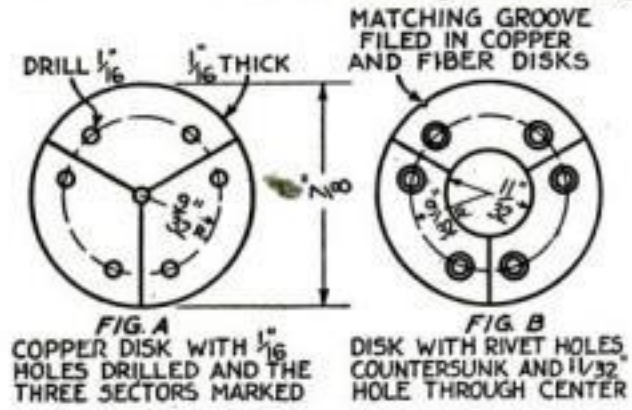
FOR his electric motor design Mr. Coover was awarded first prize in the electrical division of a national contest conducted by the Educational Department of POPULAR SCIENCE MONTHLY. He is Director of Industrial Arts Education at Beaver Falls, Pa. His boys work from blueprints and from detailed instruction sheets, of which the accompanying text is a brief summary. The necessary punches and dies are made by a toolmaker, but the expense is small when distributed over so many individual motors.

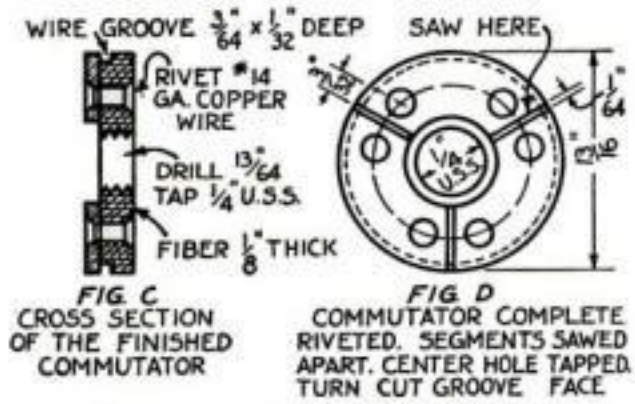
The armature laminations are punched from 22-gage steel on a hand press with suitable punches and dies. The first punch—that for the plain 1½-in. disks—has a spur center extending 1/16 in. below the cutting edge of the die to mark the center of each piece. The center hole is punched ¼ in. and the three remaining holes are punched one at a time with a 5/8-in. punch. The die for this punch has a ¼-in. axle 1/16 in. above the face of the die; and a V-groove in the face of the die is used for indexing the blanks accurately.

The complete field is punched in two pieces as shown. The thirty-two laminations, sixteen on each side, are held together by the two field brackets and two 3/16 by ¾ in. rivets. The punch has two spur centers extending 1/16 in. below the cutting edge to mark the centers for the two holes shown.

The brushes and springs can be obtained from any company that manufactures electric trains or other electrical toys. The brushes should be approximately 3/16 in. in diameter.

In assembling the armature it is necessary to have a commutator segment directly in front of each pole. Before wrapping the armature cut three insulators from 1/32-in. fiber approximately 5/8 by 1½ in., fit them into the spaces between the poles, and trim the edges to size. Cut six small pieces of fiber ¼ by ¾ in. for insulators between the wrapping and the hex nuts. The wrapping must be completely insulated from the steel core and the two nuts that hold the core in place. Use No. 24 magnet wire, wrap clockwise, and put forty turns on each pole. The armature is "series wound," the first turn of wire on pole I being soldered to the last turn of wire of pole III, and then both are soldered to the commutator segment opposite pole I. The others are connected in the same way.

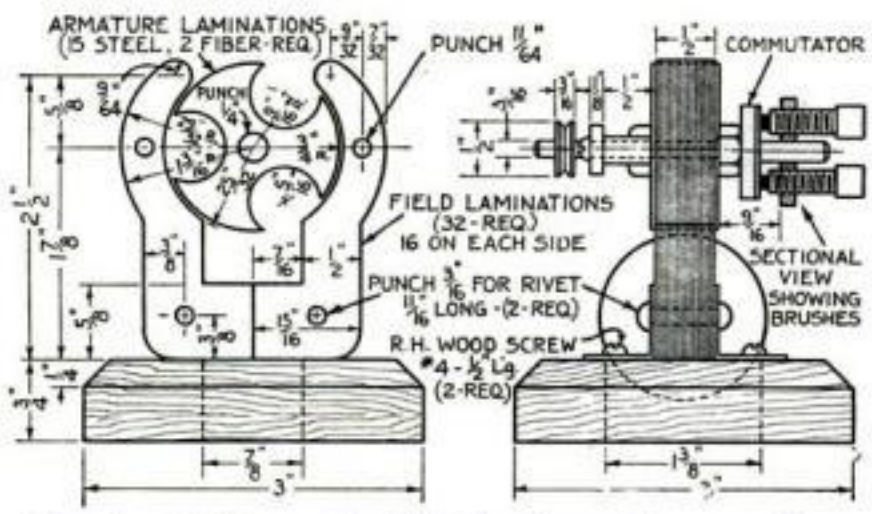




Principal steps in constructing the commutator from a 1/8-in. copper and a 1/8-in. fiber disk.

Before assembling the field, file the burred edges from all laminations. Put sixteen laminations together at one time in a vise and draw up tight. Take the two fiber insulators with the 5/8-in. square hole in the center and slip one over each group of laminations. Rivet the field brackets on the laminations with one lug at each end and rivet the field together. Take a piece of 1/32-in. fiber 3 in. long and cut it wide enough to fit the space between the circular fiber insulators. Wrap fiber around the iron core in such a manner that no part of the field wrapping can touch the core. Wrap the field with a sufficient

(*Continued on page 115*)



Two views of the toy motor which show the exact shapes and sizes of the laminations as well as the method of assembling the parts.

WALK INTO A FURNITURE STORE

WALK into the best furniture store in your town. How many pieces of *painted* furniture do you see? Almost none!

The most expensive and the most beautiful of furniture is finished in the natural wood. The expert uses dye, enhancing the beauty of his work, instead of paint, which is a camouflage for bad lumber and mediocre workmanship.

Take a tip from the professional dealer in cabinet-craft for that bookcase you're building, or that radio cabinet or that desk. There is a shade of Johnson's Wood Dye especially calculated to bring out the full beauty of the wood of which it is made. No streaks, no laps, no muddy, pigmented scum such as poor stains leave. And no smudging when it is dry. These are a few of the advantages which come with the true, clear, permanent color of Johnson's Wood Dye.

S. C. JOHNSON & SON, Racine, Wisconsin
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FREE—EXPERT FINISHING METHODS—FREE
Our expert instruction sheets on wood finishing are yours for the asking. They cover every angle of finishing all kinds of wood. Send coupon.

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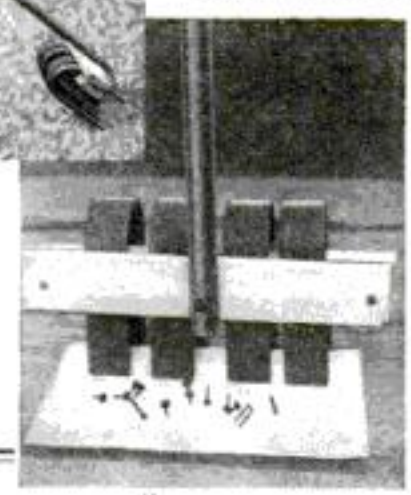
Useful Kinks for Car Owners

Making the Driveway Safe from Punctures—How to Rig Up a Bushing Press—Ideas Others Have Found Helpful

ONE reason why motorists have fewer punctures than in the early days of the game is that many more roads are hard surfaced, and that tacks, nails, and other tire damaging objects falling on the road are shared among a much larger number of motorists. That is why you are most likely to get a puncture on an infrequently traveled dirt road. The driveway to your own garage may be particularly bad. Nails and metal scrap falling in the driveway when the house was built stay there until picked up by your tires.

If you don't believe it, try fastening a number of old magneto magnets to a piece of board with a rake handle, as shown in Fig. 1, then drag the rake back and forth on your driveway. You will be surprised at the number of potential puncture producers you pick up.

Fig. 1. Cleaning the driveway of nails, metal scraps, and other tire puncturers is easy with this magnet-rake, made by fastening old magneto magnets to a piece of board with a rake handle attached, as pictured at right.



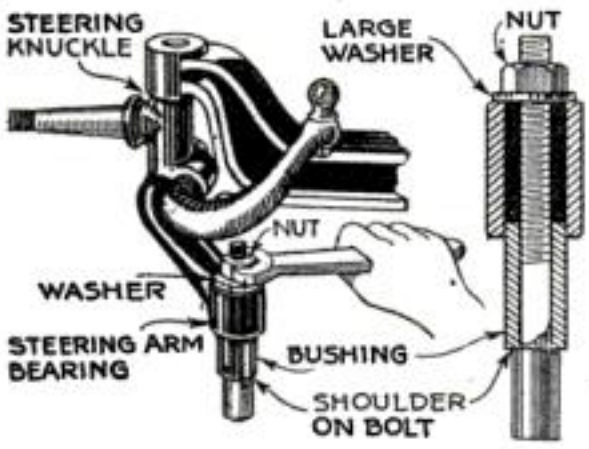


Fig. 2. Simple method of forcing bushing into place, using special bolt with nut and washer.

A Simple Bushing Press

DRIVING a bronze or brass bushing into place with a wooden mallet often is difficult and always is hard on the mallet. A much simpler way to force the bushing into place is shown in Fig. 2. Make up a special bolt with the shank slightly smaller than the hole through the bushing. The shoulder on the bolt should be square so that it will not injure the edge of the hole. By turning the nut you can pull the bushing into place easily. This method of inserting a bushing often will save dismounting the part to get it into the arbor press and may permit a job to be done where the shape of the part is such that it is hard to get at with the press. Best results will be obtained if the bolt is cut with a fine thread.

Note that when a bushing is forced into place the hole actually is reduced in size sufficiently to cause a jam if the bolt is made too close a fit.

WILLIAM J. DOUGLASS, of Missouri Valley, Ia., wins this month's $10 prize for his suggestion of a magnetic rake, shown in Fig. 1. Each month POPULAR SCIENCE MONTHLY awards $10, in addition to regular space rates, for the best idea sent in for motorists. Other contributions that are published are paid for at the usual rates.

Broken Glass Extractor

FISHING out the broken pieces of a window is difficult without some special means for grasping the edge of the glass. Fig. 3 shows how to make a tool that makes the job exceptionally easy. Take a piece of galvanized steel wire, bend it double, and form a small loop on each end. Tape these loops with ordinary friction tape. Then put bends in the wire, as shown, and pass the folded wire through a piece of ⅜-inch pipe. The bends in the wire near the small loops should be so gaged that when you pull on the wire the end of the pipe will force the small loops together. To use the tool push it down into the crack and feel around until the tape-covered loops are on opposite sides of one of the broken pieces of glass. Then, while holding the pipe stationary, pull up on the wire and the glass will be gripped tightly enough to pull it out.

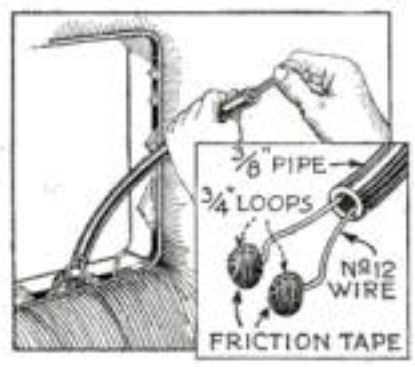


Fig. 3. Ingenious wire grips for extracting broken glass.

Filtering Out the Dust

THE level of the gasoline in the float chamber of a carburetor is controlled by a small needle valve operated by the rising and falling of the float. The action of this valve necessarily must be delicate since there is little power available to operate it. The valve itself consists of a tapered seat with a tapered pin that is ground in to make a gasoline-tight joint. If the valve does not make a tight joint, gasoline will seep past and raise the level in the float chamber above the opening in the spray nozzle and it will flow out through the spray jet and leak out of the carburetor in a steady drip.

If the valve is properly ground in, the only possible cause of such a leak is a tiny piece of foreign matter such as a piece of dust lodging between the ground faces and keeping them apart. In localities where there is much dust a frequently unsuspected source of trouble is the vent pipe of the vacuum tank. Air is drawn into this pipe part of the time, and dust goes with it. Fig. 4 shows a cure for this trouble. The vent pipe is brought back through the dash and the end is covered with a piece of old stocking material that will filter out the dust.

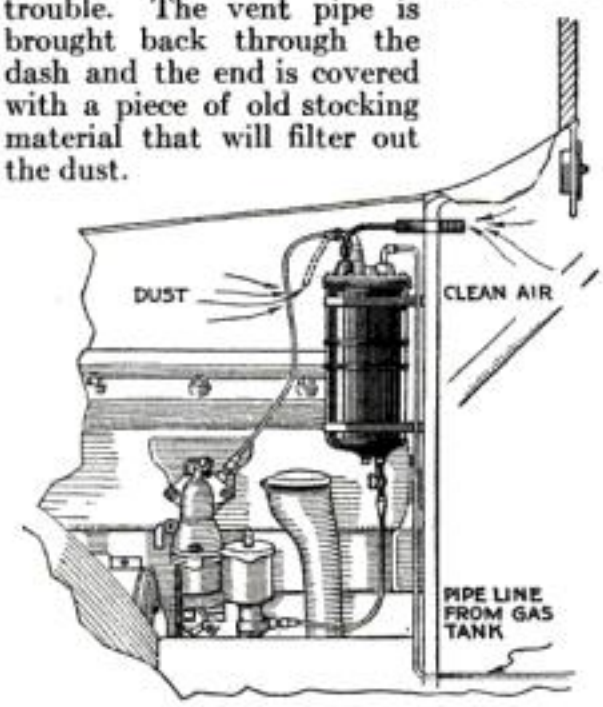
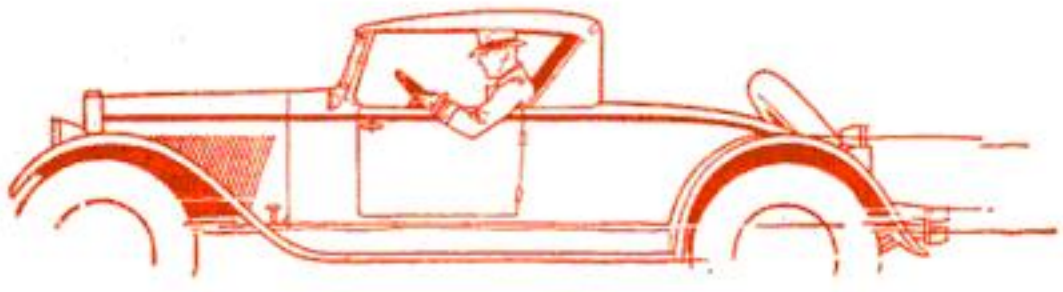


Fig. 4. How you can prevent dust particles from entering vent pipe of the vacuum tank.

30,000 miles with the first-year feel in every mile— 10% to 30% more power— with the New Mobiloil in your engine!



If the above figures about the New Mobiloil seem like superlative claims, you may be assured that the records on which they are based are even more startling.

For example: Through use of the New Mobiloil, we definitely offer you 10% to 30% more power than other oils generally sold for the same motor. Our tests have usually bettered the higher figure by a considerable margin.

"30,000 miles with the first-year feel in every mile"—may seem excessive to you. Actually, the New Mobiloil has preserved the first-year feel in many engines for more than twice this distance.

We suggest that consistent use of the New Mobiloil, plus reasonable care of your engine, will save you probably $150 a year in repair bills. Our test cars have required *no* major engine repairs or adjustments during test periods comparatively longer than an average year's running.

Finally, we have established in thousands of miles of running tests on speedways, highways and dirt roads, that the New Mobiloil stands up better and consumes more slowly at high speed than other oils—and it is now an accepted engineering fact that the oil which lasts longest and stands up best at high speed also lubricates best at any speed.

Drain and refill regularly with the New Mobiloil, and the assurances we have published here should quickly begin to demonstrate their soundness *right in your own engine.*

VACUUM OIL COMPANY

Makers of high quality lubricants
for all types of machinery

Make this chart your guide

It shows the correct grade of Gargoyle Mobiloil for certain prominent cars. If your car is not listed below, see complete Mobiloil Chart at your Mobiloil dealer's.

NAMES OF PASSENGER CARS	1929 Engine		1928 Engine		1927 Engine		1926 Engine	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Auburn, 6-66							A	A
" 8-cyl	BB	Arc.	BB	Arc	BB	Arc	A	Arc.
" other models	A	Arc.	A	Arc	A	Arc.	A	A
Buick	BB	Arc.	BB	Arc.	BB	Arc.	A	Arc.
Cadillac	BB	Arc.	BB	Arc.	BB	Arc.	BB	Arc.
Chandler Special Six	...	...	A	Arc.	A	A		...
" other models	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Chevrolet	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Chrysler, 4-cyl.		...	A	Arc.	A	Arc.	A	Arc.
" Imperial	BB	Arc.	BB	Arc.	A	A	A	A
" other models	A	Arc.	A	Arc.	A	A	A	A
De Soto	A	Arc.		...		...		...
Dodge Brothers	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Durant	A	Arc.	A	Arc.		...	A	Arc.
Erskine	A	Arc.	A	Arc.	A	Arc.		...
Essex	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Ford, Model A	A	Arc.	A	Arc.				
" Model T		...		...	E	E	E	E
Franklin	BB	Arc.	BB	Arc.	BB	BB	BB	BB
Gardner, 8-cyl.	BB	Arc.	BB	Arc.	BB	Arc.	A	Arc.
" other models							A	A
Graham-Paige	BB	Arc.	BB	Arc.				...
Hudson	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Hupmobile	BB	Arc	BB	Arc.	A	Arc.	A	Arc.
La Salle	BB	Arc.	BB	Arc.	BB	Arc.		...
Marmon, 8-cyl.	A	Arc.	A	Arc.	A	Arc.		
" other models			BB	A	A	A	A	A
Moon	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Nash, Adv. & Sp. 6	BB	Arc.	BB	Arc.	BB	Arc.	A	Arc.
" other models	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Oakland	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Packard	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Peerless, 72, 90, 91	BB	A	BB	A	BB	A	BB	A
" other models	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Plymouth	A	Arc.		...		...		...
Pontiac	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Stearns Knight, 6-80	BB	Arc.	BB	Arc.				...
" other models	BB	A	BB	A	BB	A	BB	A
Studebaker	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Velie, 8-cyl.	BB	Arc	BB	Arc				...
" 6-cyl.	A	Arc.	A	Arc.	A	Arc.	A	Arc.

the New Mobiloil

Latest Racing Yacht Model

How to Build the New Sea Scout, *an Improved Design—Easy to Make and Exceptionally Fast*

By A. M. YOUNGQUIST

The 42-in. racing yacht model adopted as a standard design by the National Sea Scouts.

MODEL sailing is a sport for men as well as boys. Boy Scouts, Sea Scouts, and "good scouts" everywhere are building and racing model yachts.

For many, this desire to own and sail a boat finds expression in purchasing a toy boat. At best this is a makeshift compared with building one's own model from carefully designed plans of a yacht that really sails well and in form and detail is as scientifically correct as any large racing craft.

High school boys in the Industrial Arts Department of the Morrison R. Waite High School, Toledo, Ohio, have been building model yachts for years. Many designs have been tried, ranging in size from 20 to 72 in. The most successful design for boys, and the one now adopted for model club and interschool competition, is the 42-in. model *Sea Scout* to be described in this and a following article.

This model has been recommended for adoption as the standard in the model building test by the Sea Scouts. A national program of racing contests in this class is under way in the Sea Scout organization. This is a challenge to boys everywhere to match their skill in building and racing these models. And it must be emphasized here that half the fun is in building them.

The average cost of constructing the *Sea Scout* is between four and five dollars. The materials are easily obtained and no extensive equipment is needed.

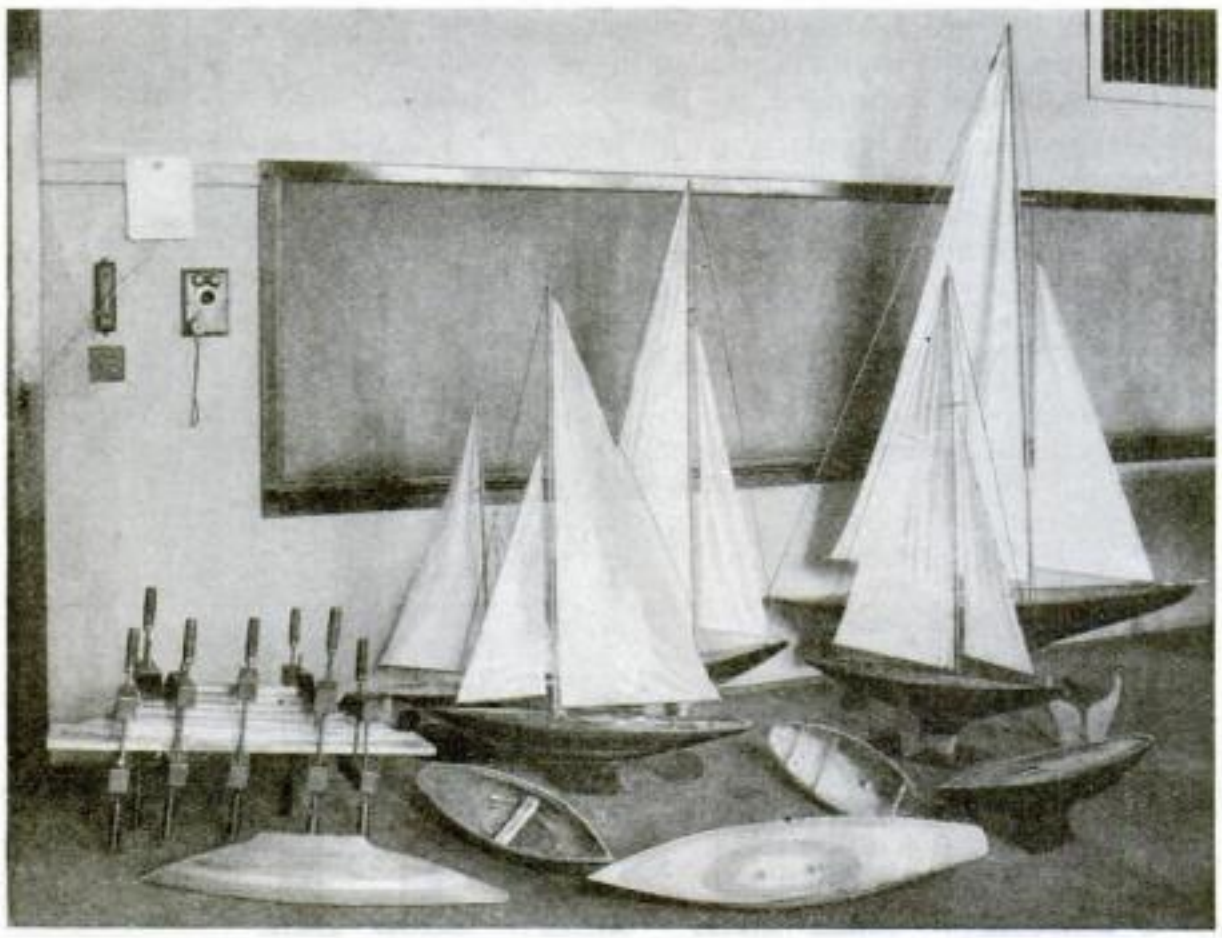
In view of the difficulty of building the model from drawings as small as those accompanying this article, two blueprints have been prepared with a full size body plan, a half size half-breadth plan, and all the necessary drawings. These can be obtained by sending fifty cents to POPULAR SCIENCE MONTHLY for Blueprints Nos. 106 and 107 (see page 111).

Besides a workbench and woodworking vise, the following woodworking tools are required: jack plane or smoothing plane, spokeshave, chisel, gouge, try-square, hand screws, hammer, nail set, screw driver, brace and bits, crosscut and rip saws, keyhole saw, knife, and half-round cabinet rasp. For making the fittings: flat file, rat-tail file, hand drill and set of drills, tinner's snips, hack saw, two or three small screw clamps, and a soldering outfit. A small metal vise is also desirable.

THE hull is constructed on the "bread and butter" or lift method, which means that the seven layers of ¾-in. wood, marked *A* to *G*, must be cut accurately to the designed water lines and then glued together. The best wood is well-seasoned, clear white pine or sugar pine without checks. The grade of white pine used by pattern makers is the best, if obtainable. The Philippine wood often used in place of mahogany makes a beautiful model in a natural finish, although it is slightly heavier than white pine. Some of the Waite High School models are built of mahogany above the load water line and white pine below.

It is advisable to make manila paper half patterns for the lifts. These can be made most conveniently by enlarging the half size half-breadth plan on Blueprint No. 106. They can be prepared, however, by fairing the lines from the table of offsets given on page 90, but this is a considerable task even for an experienced model maker.

If the table of offsets or half-breadths is used for fairing the water lines, first establish center lines and accurately locate sections or station lines at right angles to the center line and 2 25/32 in. apart. On the station lines measure from the center lines the half-breadths given in the table. Bend thin wood strips or splines to pass through these points and draw the water lines.



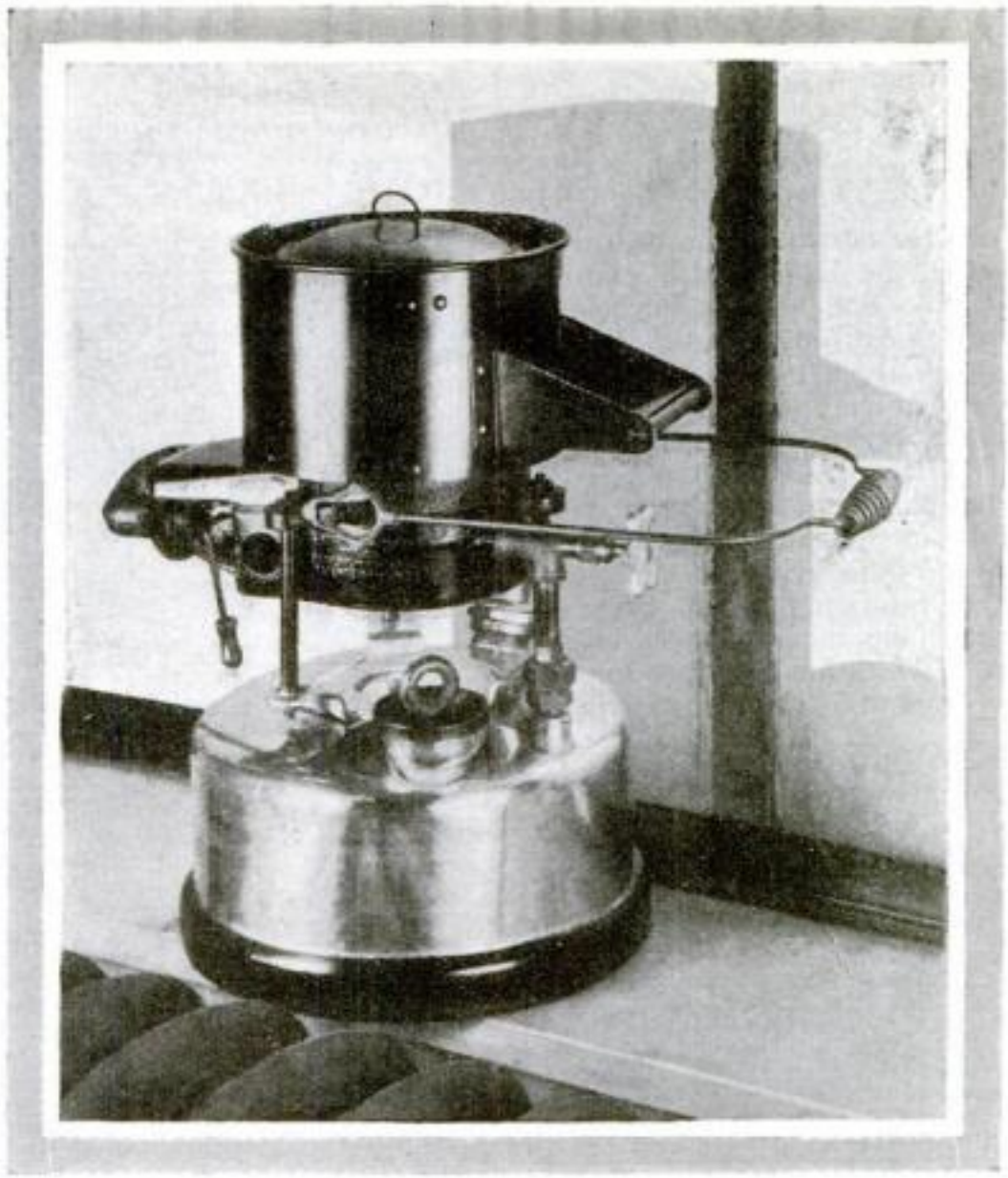
Racing yacht models built under Mr. Youngquist's direction at the Waite High School, Toledo, Ohio, and hulls in various stages of construction. The large yacht in the background is a 72-in. model.

WHEN the half patterns have been cut out, mark accurate center lines on the wood. Secure a half pattern by means of thumb tacks to one of the pieces and draw a pencil line around the pattern. It is necessary also to transfer the section or station lines to the wood in order later to locate each layer in respect to every other layer. Turn the half pattern over and draw it for the other half of the water line. Do the same for each lift. Then cut the wood with saw, spokeshave, and plane accurately to the line, leaving square edges.

To simplify the work of hollowing the hull, lifts *A* to *E* are sawed out as shown by a perspective sketch of lift *D* on page 90 and indicated in the views marked "lengthwise section" and "cross section." Exactly (Continued on page 90)

C & L 70

This is the Clayton & Lambert No. 70 fire-pot with tinner's hood. Produces a working flame in ninety seconds. Flame controlled as easily as a lamp. The burner orifice cannot be enlarged by tightening the needle valve. No chance of ruining the fire-pot that way—that's an exclusive C & L feature. Will heat a pair of soldering coppers and melt a pot of metal at the same time.



It does a lot in 90 *seconds*

Ⓢ

YOU can prime and light a Clayton & Lambert fire-pot and have a working-hot flame in ninety seconds! Then turn the flame down—retaining the heat—and watch the metal melt along with your fuel bill. That's what you do in ninety seconds with a No. 60 or 70 Clayton & Lambert. And you do it every time regardless of winds or draughts or cold weather. You can use them indoors without annoying a soul, for they're noiseless, odorless and smokeless.

Such quick, positive action comes from an exclusive Clayton & Lambert improvement. A unique method of mixing air and gas vapor in the proper proportions—*always*. That with the exclusive baffling cup assures rapid-fire starting. Another exclusive Clayton & Lambert feature is the "spider" welded to the tank. It keeps the top-structure properly aligned and all working parts in perfect true. And the uprights which give them additional strength are drop-forged and practically indestructible.

Another part made to last a lifetime is the multi-ribbed flame plate. It's built particularly strong and there's practically no chance of it breaking. If that should happen the plate is easily replaced.

Fire-pot No. 22, which is a powerful and popular coil type, has a feature that you'll appreciate. To remove the coil you loosen one nut and draw the coil through a door in the cup. That saves you a lot of troublesome work when the coil needs changing.

You're familiar enough with tools to know what these improvements mean. The satisfaction and longer service which they give have made Clayton & Lamberts the largest selling fire-pots in the world. For your greatest money's worth insist that you get a Clayton & Lambert. Look for the red band around the base of the tank. That's the sign of a Clayton & Lambert. But make sure—look for the trade-mark too. Sold at nearly all hardware and electrical stores.

C & L 22

This is the Clayton & Lambert No. 22 fire-pot. It is deservedly popular because of its easily understood design and its powerful blast. Recent improvements and Clayton & Lambert patented features make this model particularly desirable. It has a door in the coil cup which permits the coil to be easily and quickly removed. Sturdy construction and popular price make this tool a favorite with the plumbing trade.

PROTECTION C&L TRADE MARK REG.

CLAYTON & LAMBERT

MANUFACTURING CO., Detroit, Mich.

Ⓢ This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

How to Build a Racing Yacht Model

(Continued from page 88)

where to do the cutting is shown by dotted lines on the half-breadth plan on Blueprint No. 106. Use a keyhole or turning saw to cut out the interior of the lifts. Enough stock must be left for at least ½ in. of gluing surface between each subsequent layer, and at the ends an inch or more is left.

Begin with lift *A*, as the interior sawed out may be used for a smaller lift. Fit ¼-in. wooden dowels at both ends to fix the relative position of each layer and prevent any slipping or inaccuracy in gluing up. The station or section lines on each layer must coincide. It is advisable

HALF BREADTHS OUT FROM CENTER LINE									
STA.	DECK	A-WL	B-WL	C-WL	D-LWL	E-WL	F-WL	G-WL	D"WL
F.P.	0								
1	5/16	1/32							
2	1 3/32	1 1/16	23/32						
3	2 1/16	1 31/32	1 45/32	1 5/16	0				
4	2 13/16	2 3/4	2 5/8	1 11/32	1 11/16	3/16			
5	3 9/32	3 13/32	3 5/16	3 1/8	2 11/16	1 25/32	1/4		
6	3 27/32	3 27/32	3 13/16	3 23/32	3 3/8	2 25/32	1 13/32	1/4	
7	4 3/32		4 3/32	4 1/16	3 7/8	3 13/32	2 1/4	25/32	5/16
8	4 5/32		4 1/32	4 3/32	4 1/16	3 15/16	2 5/8	15/16	13/32
9	4 1/8		4 1/32	4 1/4	4 1/8	3 23/32	2 15/16	25/32	5/16
10	4 1/32		4 1/32	4 3/32	3 15/16	3 7/16	1 7/8	5/32	
11	3 27/32		3 7/8	3 13/16	3 5/16	2 3/4	5/16		
12	3 15/32		3 15/32	3 11/32	2 13/16	5/16			
13	2 25/32		2 25/32	2 29/32	0				
14	2 1/16	2 1/16	2 1/32						
15	1 15/16	1 15/16						• DEADWOOD	
TRANSOM	1 1/2	1 1/2							

STATIONS SPACED - 2 25/32"	LENGTH OVER ALL - 42"
WATER LINES SPACED - 3/4"	LENGTH L.W.L. - 27 13/16"
DRAFT - 7"	BEAM L.W.L. - 8 1/8"
LEAD - 5.3 LBS.	SAIL AREA - 735 SQ. IN.
DISPLACEMENT - 390 CU. IN.	RATING - 22

Offset table for making a full size half-breadth plan, and specifications and rating of the model.

to mark the midship station (No. 8) distinctly on each lift and to make these marks coincide. Care should be taken not to have the dowel holes too deep or they may come through when the outside corners are pared away in the final shaping of the hull.

Before gluing make a careful trial clamping with wood hand screws. If plenty of hand screws are available, lifts *A*, *B*, *C*, *D*, *E*, *F*, and *G* are glued together at one time. If the number of hand screws is limited, one lift may be glued on at a time. When no hand screws are available, the necessary pressure may be obtained by using weights or by fitting strong backs and bolts for tightening. Care should be taken not to apply too much pressure, which might crack a lift.

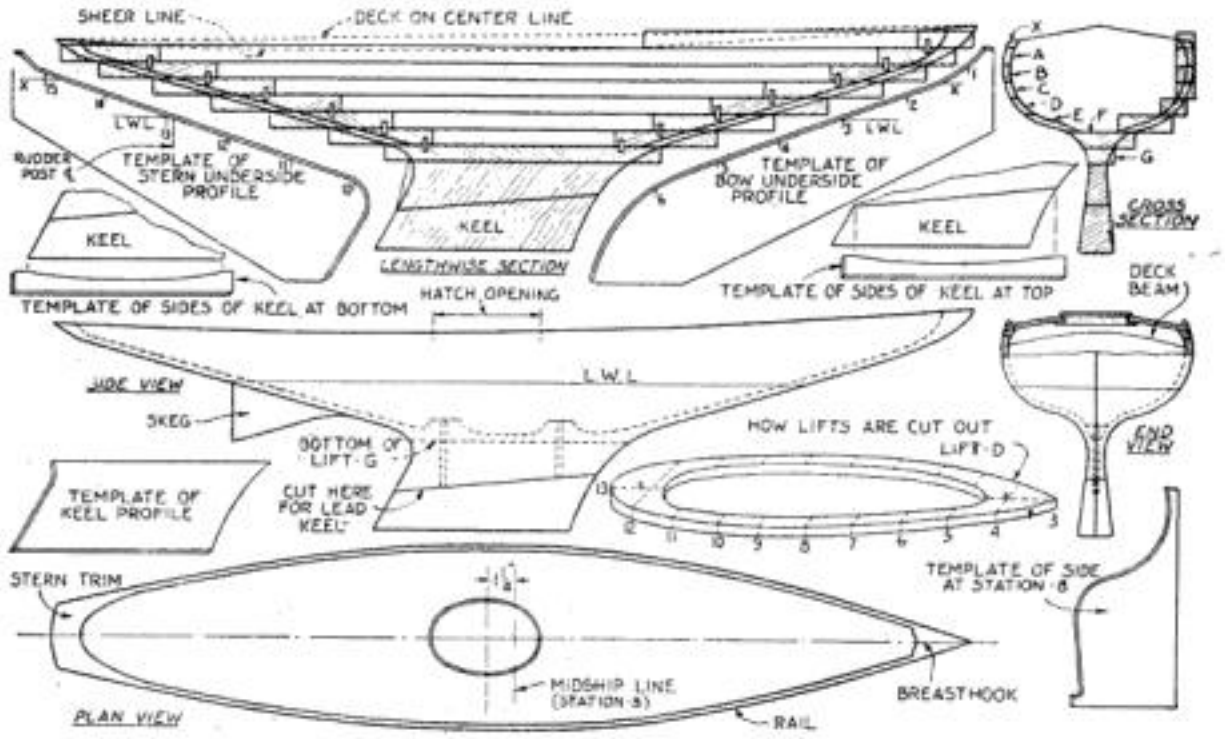
A waterproof casein glue, mixed according to the manufacturer's directions, should be used. Casein glue, which comes as a white powder, is mixed with cold water to a consistency of thick cream. It should be stirred continuously for twenty minutes before being used. Mix only enough to finish the job in hand, as it soon hardens and is then unfit for further use.

When the lifts are glued up and the glue has hardened for at least twelve hours, secure the model to the bench top by clamping it with hand screws at lift *A* or by fitting wooden cleats or dogs to the bench top. With a chisel, gouge, plane, and cabinet rasp, cut off the square corners just to the lift edges and sandpaper the whole smooth. This should give the correct shape to the hull.

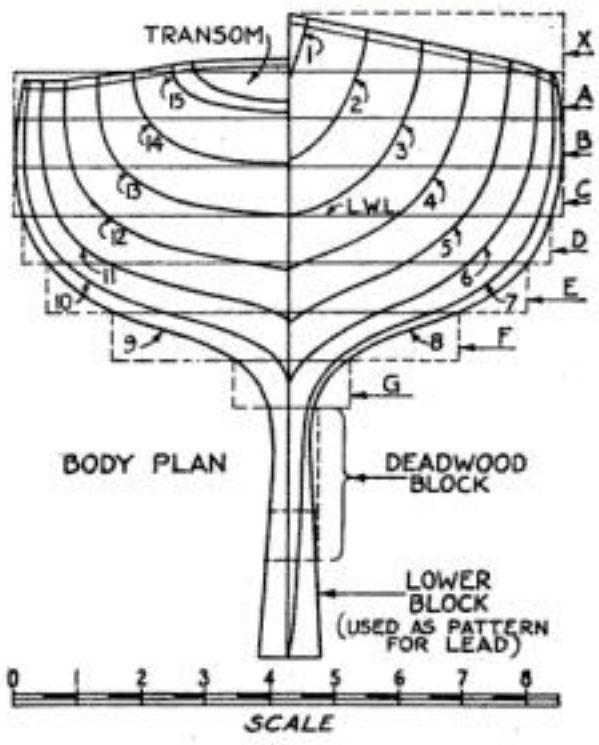
IT IS sometimes advisable to make cardboard templates from sections or stations *4*, *6*, *8*, *10*, and *12* on the body plan for testing the model form, as indicated in the drawing above and in the photograph on page 110. Leave the forward half of the lift *A* with square edges to allow lift *X* to be clamped on a little later. Leave the bottom lift *G* with square edges but gouge out part of the interior.

Clamping the model in the vise by means of the square edges on lift *G* is not as secure as it might be because of the rounded form, so first gouge out the interior at the bottom in lift *F* only sufficient to allow the keel bolts to be inserted. When this is done, cut out to the profile the "deadwood" portion of the keel and glue it on, holding it by means of the ¼-in. (or 5/16-in.) keel bolts instead of clamps. This deadwood piece now is a firm member for securing the model in the vise for gouging out the remainder of the interior, as shown on page 110. The lower part of the keel block, if made of two pieces temporarily screwed together, will later serve for making the keel pattern.

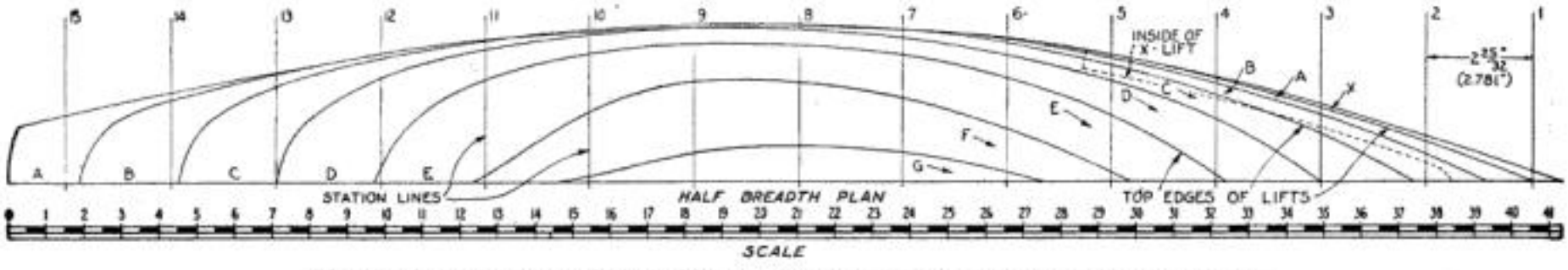
In gouging out the interior, care must be taken to work with the grain of the wood and to test often so as not to cut through the hull. Holding the hull over a strong light will (Continued on page 110)



Working drawings of the *Sea Scout* hull showing how the lifts are cut out, how they are doweled and glued together, and how the final shaping is completed with the aid of carefully made templates.



Body plan showing the shape or cross section of the hull at the station points 1 to 15 and stern.



Plan showing the shape to which the lifts are cut. For a larger and more complete drawing of this and all other necessary plans, refer to our Blueprints Nos. 106 and 107, which are listed on page 111.

How to Use a Circular Saw

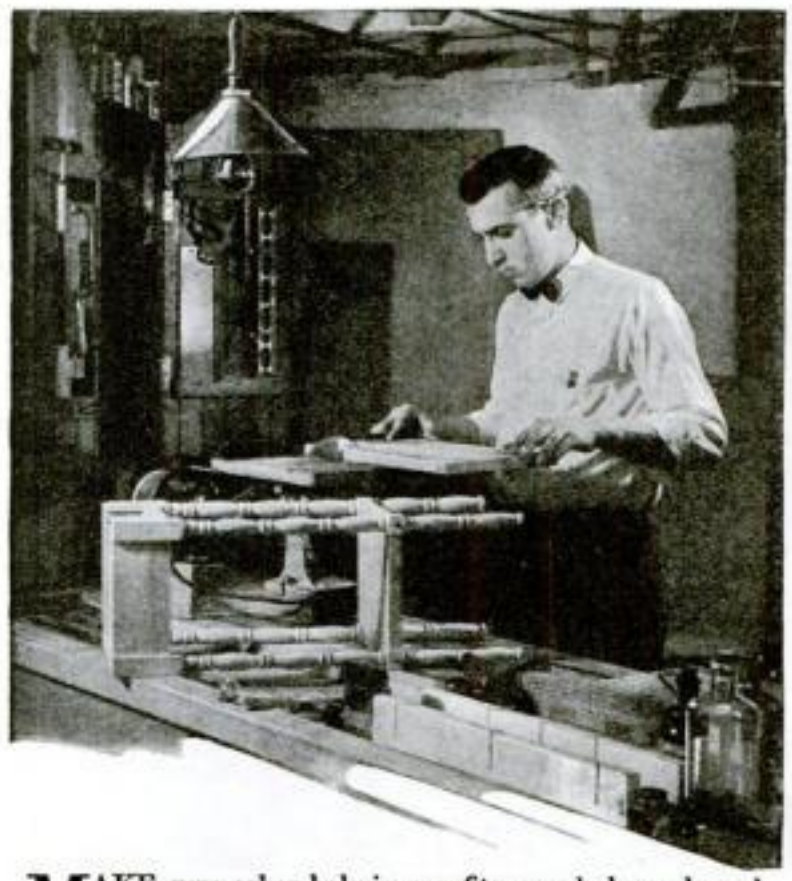
Told by the World's Foremost Saw Makers

YOU know Disston as the maker of the great saws used in the lumber industry. And Disston also makes circular saws and band saws for *you*: for every type of portable rig and bench outfit. Small circular saws of the same Disston quality as the 110-inch saws (the world's largest circular saws) made by Disston for cutting the giant logs of the West Coast. Small band saws of the same quality as the great Disston Band Saws used in the big lumber mills and famous among lumbermen for their hardness, toughness, and temper. Saws made possible only by Disston Steel, from Disston's own steel furnaces.

Ask for "Disston"! Hand Saws, of course; but also Disston Circular Saws, Band Saws, Tools and Files.

Files for the Wood Worker

Disston Cabinet Files (fine teeth) for smoothing and finishing wood surfaces, easing tight doors and drawers, etc. Disston Wood Rasps (coarse teeth) for rough and fast cutting, enlarging holes, etc. Half-round 8" Cabinet File, 65c. Flat 8" Wood Rasp, 50c.

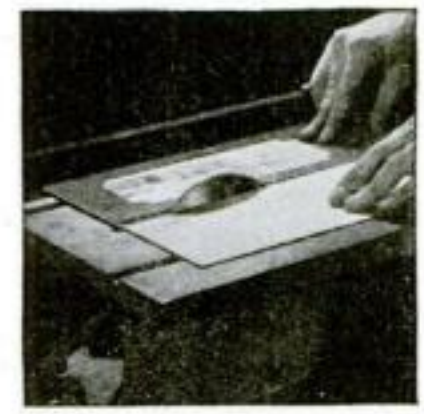


MAKE sure arbor hole in saw fits mandrel snugly and that collar and nut are tight, to prevent saw wobbling in the cut or turning on the shaft.

Before starting, see that saw has ample clearance at sides and ends of table slot. Test by turning by hand. If table can be moved up and down, set it so cut will come as near center of saw as possible. This gives best cutting angle on saws up to 8", and lessens tendency of material to "ride" over the top of the saw.

Get enough speed. Have belt tight. Don't adjust table when saw is running.

Stand to *left*, not back of, board to be cut. Hold down work with left hand, just ahead of right. Push work through with right hand. When gauge is close to saw, use a "push stick" notched on the end. Do not "crowd" the saw: if it binds, ease up on the feed.



For Cutting Soft Metals

You can use a Disston Metal-Slitting Saw on your power outfit. Cuts sheet brass, zinc, copper, etc. Disston makes metal-cutting circular saws from ½" to 90" diameter. Write for information and prices on Disston Metal Cutting Saws for any purpose.

Handiest of Pocket Levels

For trueing up construction work, levelling shelves, etc., use a Disston Featherweight Pocket Level. It is the lightest and handiest level made. Length, 9"; weight, 2 oz. Aeroplane aluminum. Three proved glasses. $1.25.

Band Saws for Better Work

Disston "Thin Gauge" Narrow Band Saws are 2 to 3 gauges thinner. They run better on machines with wheels up to 24" diameter. Saw 9' 8" long, ½" wide, 25-gauge, brazed, $2.17. Other sizes in proportion.

For Cutting Dovetails, etc.

Wherever a fine joint is needed, and for careful cabinet work or pattern making, use a Disston No. 68 Dovetail Saw. Blade extra thin, with fine teeth. The 8" blade, 17 points to inch, is most popular. $1.60.

Use Disston Circular Saws for better work on any machine. Cross-cut (left), for cutting across grain; Rip Saw (center), for cutting with grain, or a Disston *Combination* Saw (right), which cross-cuts, rips and miters perfectly.

Your hardware dealer has in stock, or can get for you quickly, any size or style of Disston Circular Saw.

"The Saw Most Carpenters Use"

The two handiest saws for the home workshop are the 26-inch 8-point for cross-cutting, and the 26-inch 5½-point for ripping. You will need these on almost every job. The popular "D-8" Lightweights cost $3.45.

DISSTON

***Makers of* "THE SAW MOST CARPENTERS USE"**

Every saw user will enjoy reading "The Disston Saw, Tool and File Book," an illustrated manual on the selection, care, and use of tools. It tells how to file and set saws, etc., and contains helpful information on circular saws. Use the coupon, or write for it.

Henry Disston & Sons, Inc., Philadelphia, U. S. A.
(In Canada, address Henry Disston & Sons, Ltd., Toronto)
Please send me "The Disston Saw, Tool and File Book."

Name and Address.....

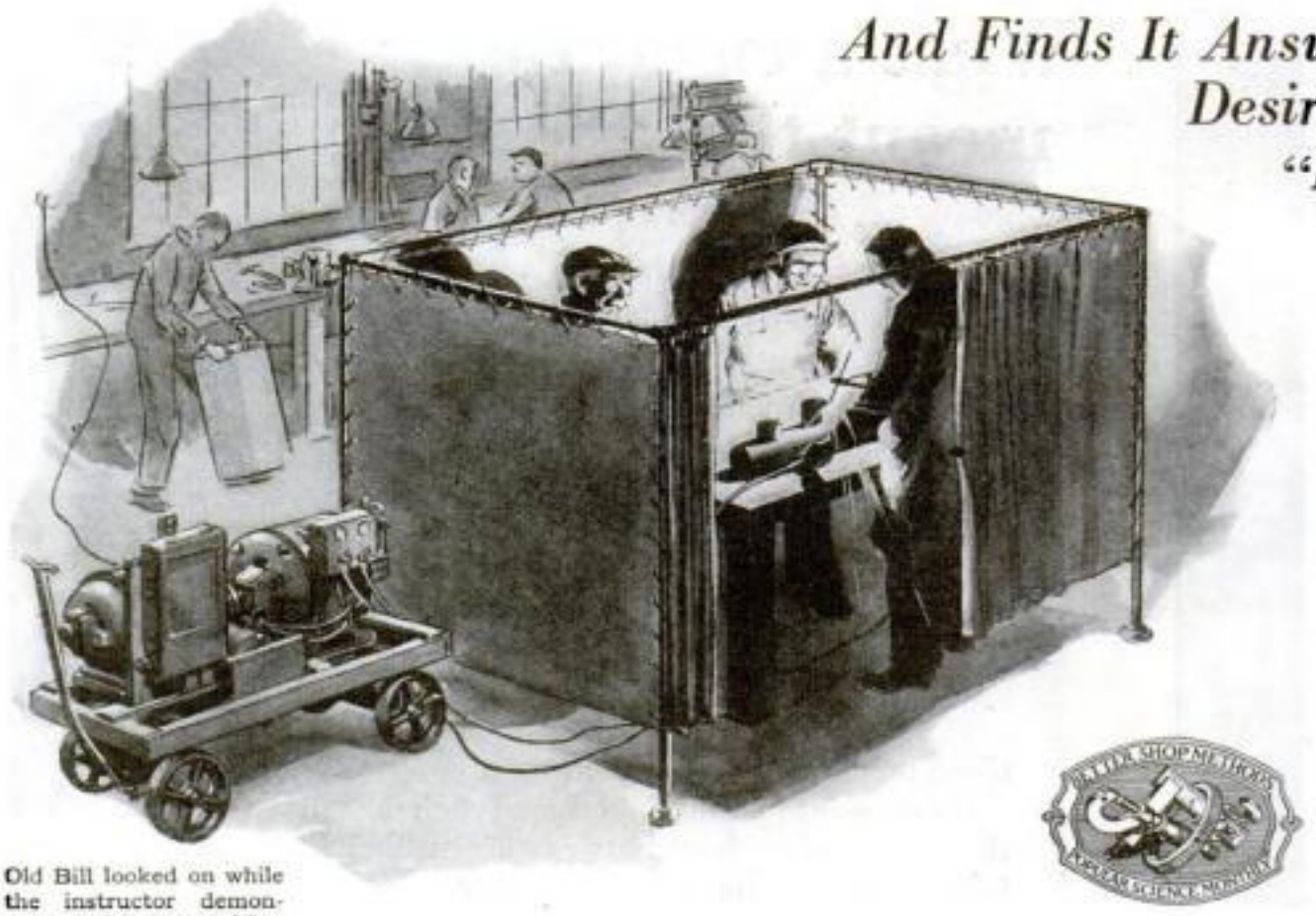
This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Old Bill Buys an Arc Welder

And Finds It Answers His Lifelong Desire for an Efficient "Putting-On" Tool

By

JAMES ELLIS



Old Bill looked on while the instructor demonstrated the new welder.

OLD BILL'S eyes saw a beautiful spring landscape, but his thoughts had rambled back to a trying day when he was beginning his shop career. He could see in vivid memory the very machine frame to which he had so laboriously been endeavoring to fit a patch. Oh, for a "putting-on" tool! . . . Well, such tools were available now. Indeed, he would be compelled to buy a new one of the latest type if he were to keep up with the march of progress. Yes, his company would have to purchase an electric welder.

Only two days before he had received an offer from a new manufacturing concern for some work that could be done only with an electric welder. He had told the engineer in charge that he would consider the purchase of a welder and let him know. His mind made up, Old Bill now telephoned to his new customer that in about a week he would have the welder.

The uncrating of the new machine caused considerable excitement among Old Bill's boys. They gathered about it.

"I bought a motor-driven machine that can be connected to our regular shop current," Old Bill explained to Bob Laten, his right-hand man. "We shall have more wiring put in about the shop so that we can plug in at several places, or wherever there is work to be done."

"That looks like a couple of motors to me," commented one of the apprentices.

"You are not far from right," Old Bill replied, glad of an excuse to explain the machine. "One end is a motor, while the other end is a direct current generator capable of producing a current of relatively low voltage but of high amperage; that is, it makes a heavy current. The thing that looks like a third motor is the exciter for the generator.

"THE way the welder works is simple enough. An electric arc is started by making a momentary contact with the welding rod, or electrode, and the piece to be welded, then drawing the welding rod away so that an arc is formed. When the arc is going properly, a very intense heat is created, something like 6,000 degrees Fahrenheit, which is enough to melt steel readily. Then, if the current is flowing in the right direction, molten metal from the welding rod is carried across the arc and deposited on the piece being welded. It makes no difference if the arc is overhead, the metal is carried across and deposited just the same."

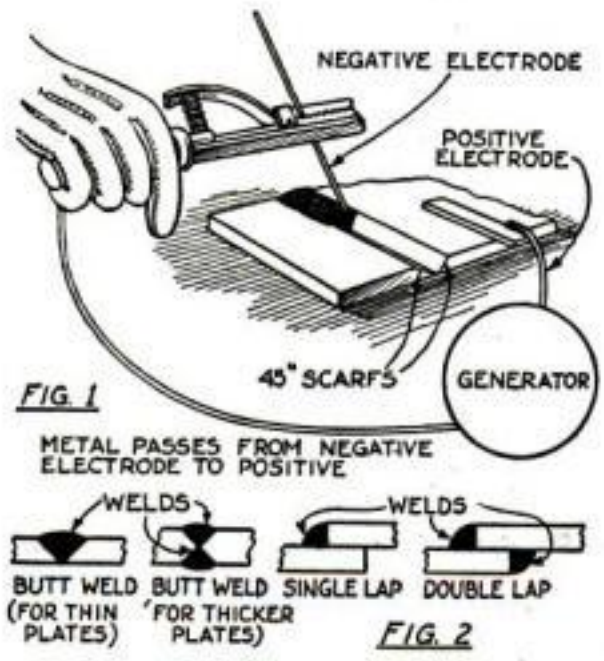
"Can we use this machine on cast iron?" Old Bill was asked.

"We cannot weld cast iron in the same manner that we would with the acetylene torch," Old Bill responded, "but we can deposit steel on cast iron, and in that way make a repair. By using a carbon stick in place of the metal electrode, we can weld cast iron, but then the machine furnishes heat only, and does not deposit the metal. In that case, the welding is done in much the same manner as with a torch."

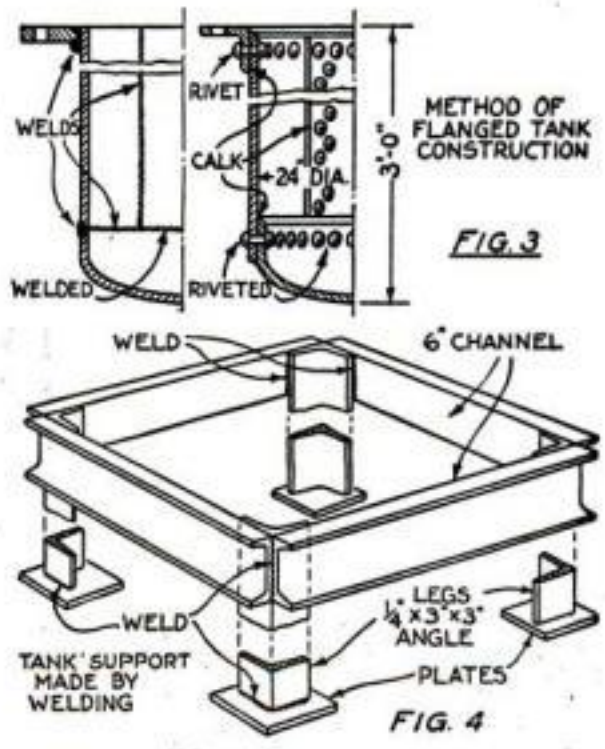
The initial excitement was still maintained a few days later when an instructor came from the factory to show some of Old Bill's men how to make good welds. He found that several of them had read books about electric welding and had a good general idea of how the work was done.

"One of the advantages of the electric process," he explained, "is that it is not necessary to have the entire weld hot, as you do with a torch. This means that parts can be joined without leaving shrinkage strains. However, you must do your part, and the way this is accomplished is by what we call a 'step back' method of welding. We try to weld just a few inches at a time, and then move to another part of the job to avoid overheating. In case we are welding thick plates—say five eighths of an inch—we make the weld in three layers. Another thing to bear in mind at all times is that the scarfs must be clean and free from rust and scale. There is no way of floating impurities out of the weld as you do with torch work."

One of the first things that the instructor from the (Continued on page 120)



How two thin plates are welded together, and four much used types of butt and lap joints.



Comparison between a riveted and a welded tank, and a tank stand made with welded joints.

Starrett Hacksaws

Cut Quicker—Last Longer

There is a Starrett Blade and a Starrett Frame that will give you the one best combination for *low cost per cut.*

Ask your tool dealer to show you Starrett Hacksaws and Frames. Try them. See for yourself why it pays to insist on Hacksaws bearing the name of the world's greatest toolmakers — *Starrett.* Also ask for a copy of the Starrett Catalog No. 24 "W" —sent free on request.

THE L. S. STARRETT CO.
World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
Steel Tapes—Standard for Accuracy
ATHOL, MASS., U. S. A.

The blades for super Service — Starrett High Speed Hacksaws. Have you tried them?

No. 151 Hacksaw Frame, excellent for work in close quarters.

No. 153 Pistol Grip Frame. Sturdy, convenient, low in price.

No. 146, a popular and substantial frame.

No. 169 Easy Grip Frame of exceptionally fine design adjustment, rigidity and 'hang'

Use Starrett Hacksaws

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

How Wood Aids the Machinist

By H. L. WHEELER

FROM the nature of their trade, machine-shop men are trained to think in terms of metal. Yet on occasion it is to their advantage to consider other materials, particularly wood. There are times when a fixture must be built in a hurry; this gives a mechanic who has a knowledge of the uses of wood an opportunity to devise something to serve the purpose.

In this very particular the so-called "engineering mind" differs from that of the mechanic who is a specialist in one or

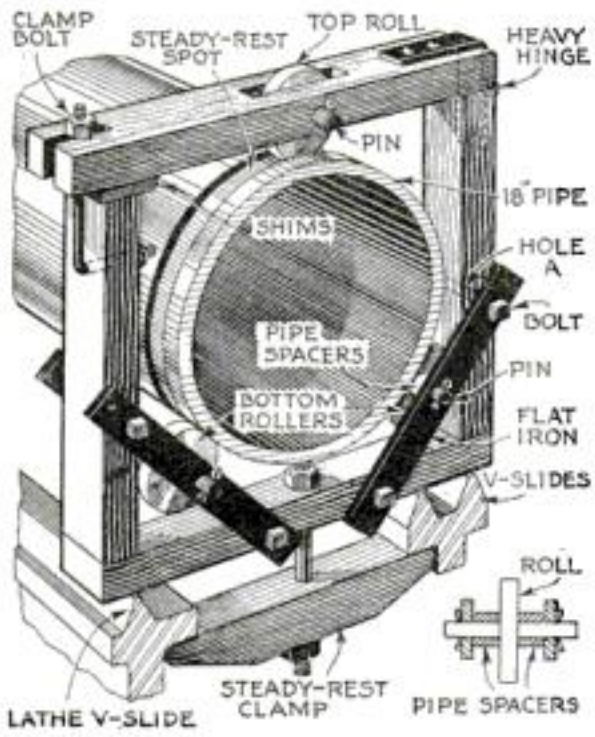


Fig. 1. Steady rest built cheaply and quickly of wood to hold a large pipe for boring the end.

a few lines, for the engineer will use the material that is best under the circumstances even though it is cheapest and most commonplace. Hence engineers frequently make temporary structures of wood, which is cheap and easily fabricated, and permanent ones of steel and masonry.

A certain machine shop in which this viewpoint was allowed to have full play obtained economies of both time and money. For example, Fig. 1 shows a lathe set up with a large pipe, or tube, which was to be turned on the outside and had to have plugs pressed into the end.

Now, it is not such a difficult task to turn the outside of a pipe with the aid of a bull center or spider, but it is a different matter to bore out the end of a large pipe in a small lathe. The pipe

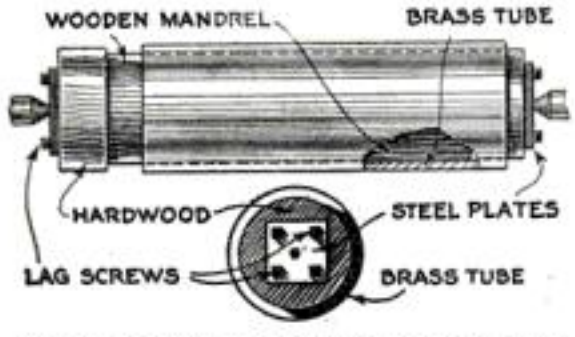


Fig. 2. Mandrels or arbors for turning brass tubing can be made economically of wood.

Old Bill *Says*—

WHITE or red lead is a good lubricant for the elevating screw of your milling machine.

Use an old micrometer to rough out all your work; save your good "mikes" for the final readings.

Oiling a machine and oiling its bearings are far from being one and the same thing.

Make sure that the heel of a milling cutter does not drag on the work.

The headstock center can be used to help locate work held in the chuck or on the faceplate. Enter its point into a hole and support the other end on the tail center; then use an indicator.

An angle plate can be set more accurately and quickly on a milling machine with an indicator than with a square.

Do not revolve the work too rapidly when using a portable grinder in the lathe.

shown is 18 in. in outside diameter and 14 ft. long, and is being handled in a 24-in. lathe. Of course, the pipe could not be swung in the steady rest of a lathe of that size.

An imaginative machinist built a cheap steady rest of wood that served the purpose just as well for this job as one made of heavy castings. The steady rest consists of three rollers, which were found in the shop's junk pile, mounted in a frame made of oak. The base is held to the lathe bed by a bolt that passes through the clamp belonging to the regular steady rest.

The pipe was prepared by turning spots for the steady rest with the aid of a spider. Then the rollers were adjusted to fit the pipe while the tail center was still in place, and the holes marked *A* were bored.

It was thought that it might be necessary to turn the tool upside down and cut on the back of the tube to prevent chatter, but this was not the case: the weight of the pipe was sufficient to prevent any uplift with the light cuts taken.

Another application of wood that is more common is its use for mandrels or arbors for turning brass tubing. Wood is an admirable material for this purpose, as it is light, easily handled, and cheap enough so that there is not a large amount of money tied up in mandrels for the

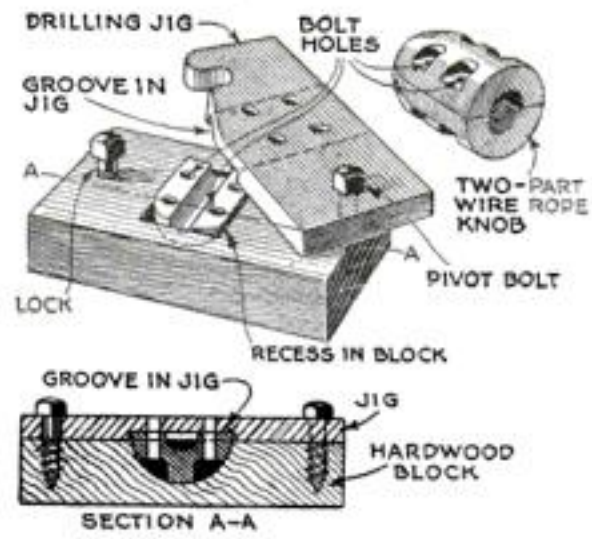


Fig. 3. Jig with wooden base for drilling small quantities of knobs used on elevator cables.

occasional job. In Fig. 2 is shown an arbor that has steel plates fitted on the ends to prevent wear.

Still another place where wood serves well is shown in Fig. 3—a jig for drilling each half of certain knobs used on elevator cables. The knobs are not made in sufficient quantities to warrant an expensive jig, and a piece of hard maple with a recess carved out to fit the knob serves as well as anything could.

Fig. 4 shows a stand to aid the drilling of oil-cup or set-screw holes in pulleys. All too frequently the pulleys are held by hand, with the result that many drills are broken. Sometimes wooden V-blocks can be used to advantage, as shown in the same illustration.

A machinist who required a pulley for a motor found that none was available. He knew where there was a piece of well-dried oak, so he put it in the lathe and made a one-piece pulley in no time. Although there was danger of splitting when the key was driven in, the wood was strong enough to stand all of the stresses imposed in actual service.

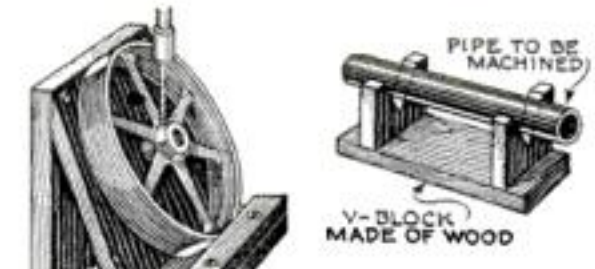


Fig. 4. Parts that are to be drilled sometimes can be supported to advantage on fixtures like this V-block and pulley stand.

Rule Depth Gauge No. 615 with a rod

This depth gauge uses a 4" or 6" rule and also a 5/64" rod, especially desirable in measuring the depth of small holes.

Toolmakers' Clamp No. 756

Pieces that an ordinary clamp cannot hold are easily dealt with, thanks to the extra long jaw with its unique auxiliary screw.

Rule Depth Gauge No. 616

The blade of this new gauge may be adjusted to any angle, making a convenient protractor of the tool. The six inch blade is graduated in 32nds and 64ths of an inch.

Universal Dial Indicator Set No. 740

This is an accurate indicator of conveniently small size and extreme durability. The design of the set and its attachment enables the user to adjust it to almost any position.

Twist Drill and Machine Screw Tap Gauge No. 707

Tells at a glance the correct drill to use with any common size of machine screw tap. Legible figures tell the size of tap, pitch of thread, size of drill required, etc.

Many a Job Simplified

= 5 New Tools

Look at the tools shown — all new, all different. Each can do easily jobs which you have probably done with some difficulty in other ways. Ease in doing work is a characteristic quality of Brown & Sharpe tool design.

And these 5 new tools have the same high qualities that have made a Brown & Sharpe the standard of comparison the world over and are well fitted to take their place in the complete Brown & Sharpe line of over 2300 tools.

Examine these new Brown & Sharpe tools at your dealer's and obtain at first hand an idea of their full value and handy design. You'll want some of them in your kit so that you can use them frequently. If your dealer cannot show them to you let us send you a catalog. Department P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

B·S

"WORLD'S STANDARD OF ACCURACY"

BROWN & SHARPE TOOLS

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

A radio table which has a rich and ornate appearance yet is not particularly difficult to make.

Fancywork *for* Your Lathe

How to Prepare Split and Oval Turnings and Moldings—Radio Table and Mirror Designs

By HERMAN HJORTH

SPLIT turning is a form of furniture decoration that came into vogue in the early part of the seventeenth century during the Jacobean period. Jacobean furniture has again become popular and reproductions adapted to modern needs are made by many high-class furniture manufacturers.

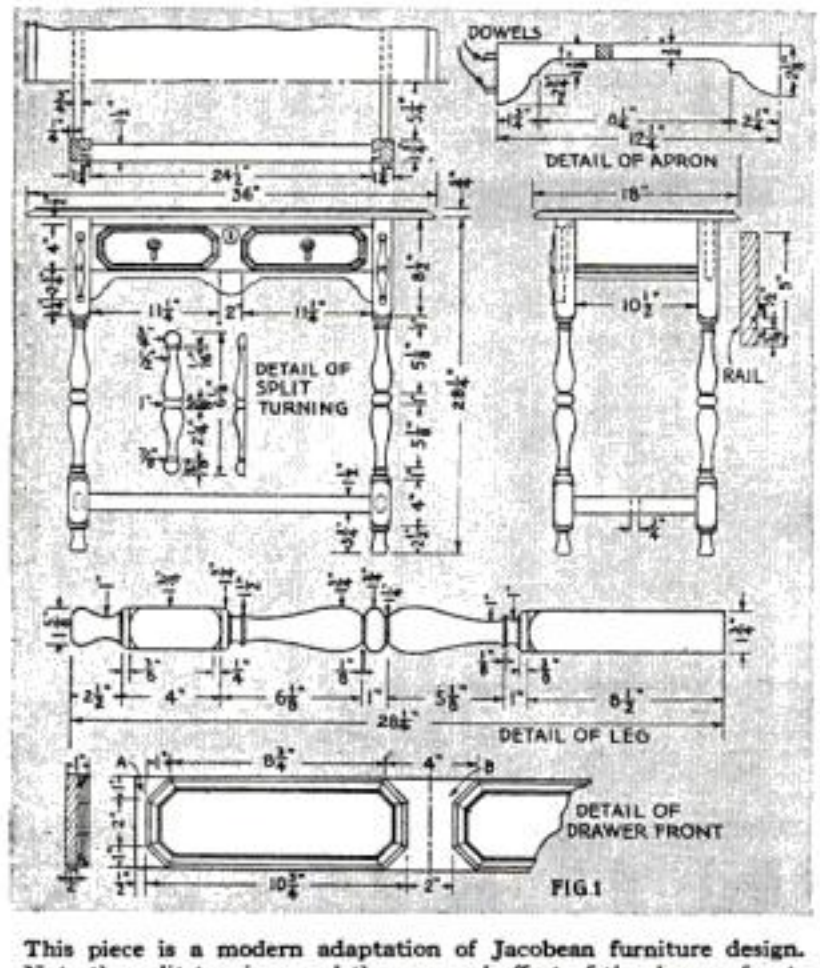
As the name implies, split turning means that ordinary turned work is split or divided into two or more parts, which in turn are glued to flat wood surfaces (see Figs. 1 and 2). Obviously, it would be impracticable to split or divide a solid turned column; split turnings are therefore made from separate pieces of stock fastened together before they are turned.

If turned halves, such as those used to decorate the radio table and the mirror frame, are to be made, the method of procedure is as follows:

Prepare two pieces of stock, making them a little wider than the greatest diameter of the turned pieces, and about 3 in. longer. The thickness of these two pieces should be equal to half their width, and they should be planed so that their faces fit accurately against each other. They may be fastened by screwing their ends together in the manner suggested in Fig. 3, by gluing their ends together for a distance of about 1½ in., by gluing them throughout their entire length with a piece of paper placed between the joint, by bolting them together as in Fig. 4, or by driving corrugated fasteners into the end wood at both ends. The work of fastening them together must be carefully and securely done.

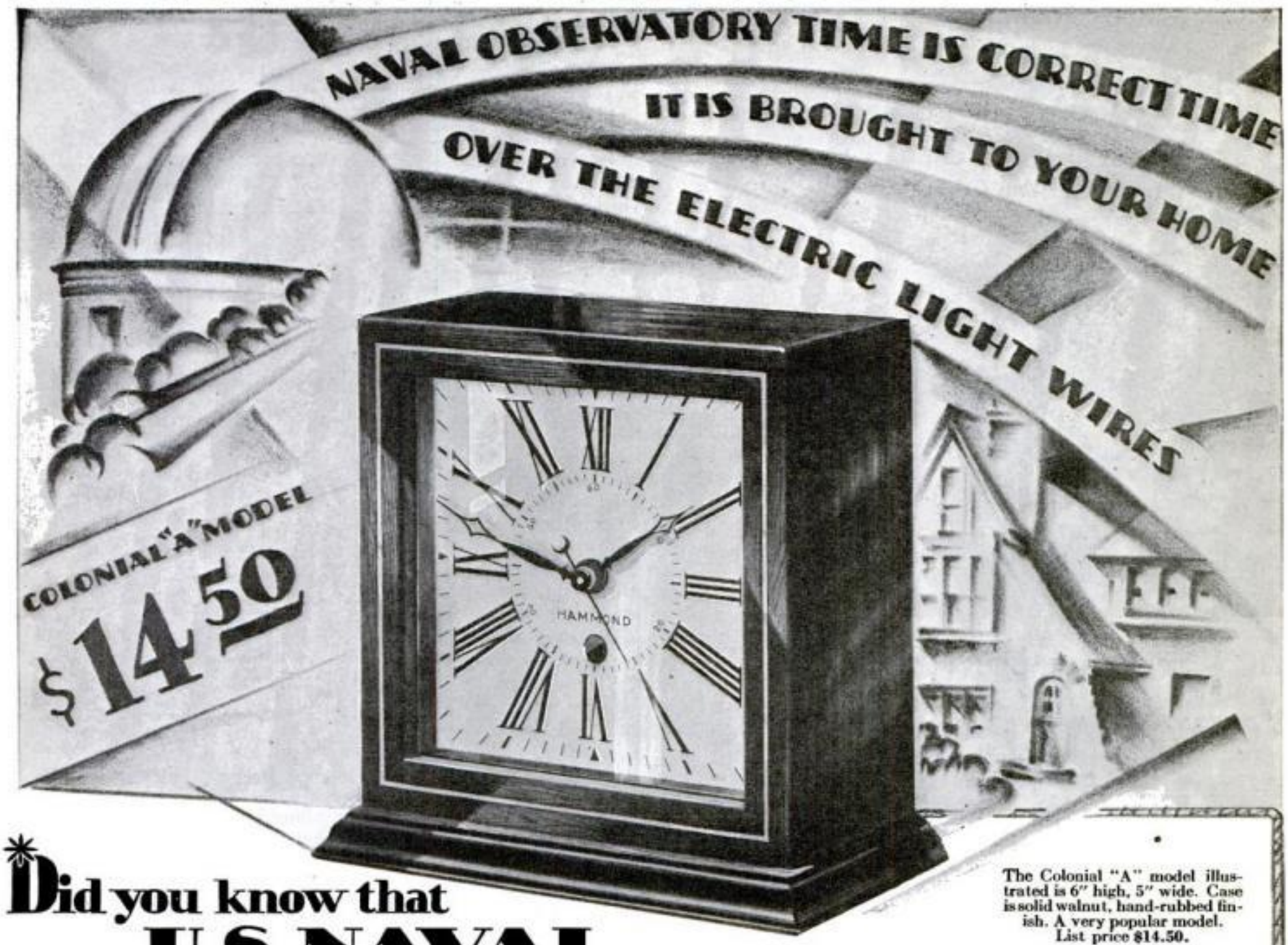
The pieces are now set up in the lathe and

(*Continued on page 100*)



This piece is a modern adaptation of Jacobean furniture design. Note the split turnings and the recessed effect of the drawer front.

HAMMOND ELECTRIC CLOCK



The Colonial "A" model illustrated is 6" high, 5" wide. Case is solid walnut, hand-rubbed finish. A very popular model. List price $14.50.

Did you know that U.S. NAVAL OBSERVATORY TIME SERVICE is waiting at your light sockets?

TAKE ADVANTAGE OF IT WITH A HAMMOND ELECTRIC CLOCK

TO install a Hammond Clock to take advantage of this new service you merely plug it into any light socket in your home. Every Hammond Clock is provided with a plug and cord for this purpose.

You then set it as you would any ordinary clock and it proceeds automatically and without further attention to tell off U. S. Naval Observatory time.

How does this wonderful new clock operate and why must it always keep accurate time? It draws the electricity for its operation from the light socket to which it is attached and impulses in that same electricity determine its exact movement and therefore how fast it runs and what manner of time it keeps. Your Electric Light Company accurately times these impulses so that your clock will tell off the same time as a master clock they have installed in their main station and which gives them U. S. Naval Observatory time direct from Washington, D. C. This, then, is the explanation of why the Hammond Electric Clock keeps such marvelously accurate time and how it can bring you Observatory time—it is automatically regulated for you every few minutes by your Electric Light Company.

Your Light Company makes no charge for this time service—it is gratis. Take advantage of it with a Hammond Electric Clock.

Hammond Clocks require only 2 watts to operate. Therefore their cost of operation is negligible—less than 10c a month.

Hammond Clocks need never be wound because they are direct electric drive. They need never be regulated because they are automatically regulated for you by electricity from the central station of your Electric Light Company.

They contain no springs and never require oiling.

This is the modern way to keep time—accurate to the fraction of a second—U. S. Naval Observatory time in your own home by electricity. You too, can enjoy it. See your dealer or write us for descriptive circulars.

Gothic Mantel Model

The Gothic "B" Mantel model is 12" high, width of base 9¾". Dial 5½" in diameter—silvered Sunray finish. A most handsome ornament and of course a perfect timekeeper. You would expect this model to sell at $50, but the price is only $29.50.

10" wall model for stores and offices (not illustrated) $22.50.

*Practically all Power Companies supply time service (regulated frequency). Some Power Companies as yet do not but if in doubt ask your jobber or ask the Power Company.

THE HAMMOND CLOCK CO.
4115 Ravenswood Ave., Chicago, Ill.

Please send descriptive folder on the Hammond Electric Clock.

Name.....
Address.....
City or Town.....
State.....PS6

Fancywork for Your Lathe

(Continued from page 98)

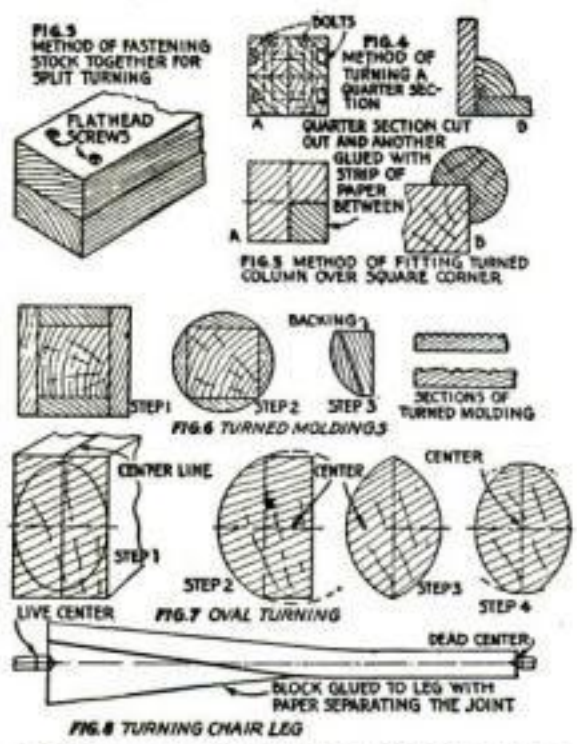
turned between centers in the usual way. When the turning is completed, the pieces are removed, and the two ends holding them together are cut off with a saw.

When quarter sections are wanted, four pieces are fastened together as shown at *A*, Fig. 4. At *B* is indicated how a quarter section may be used in a corner. Turned quarter sections are often used on chests of drawers, clock cases, mirror frames, and other pieces of furniture.

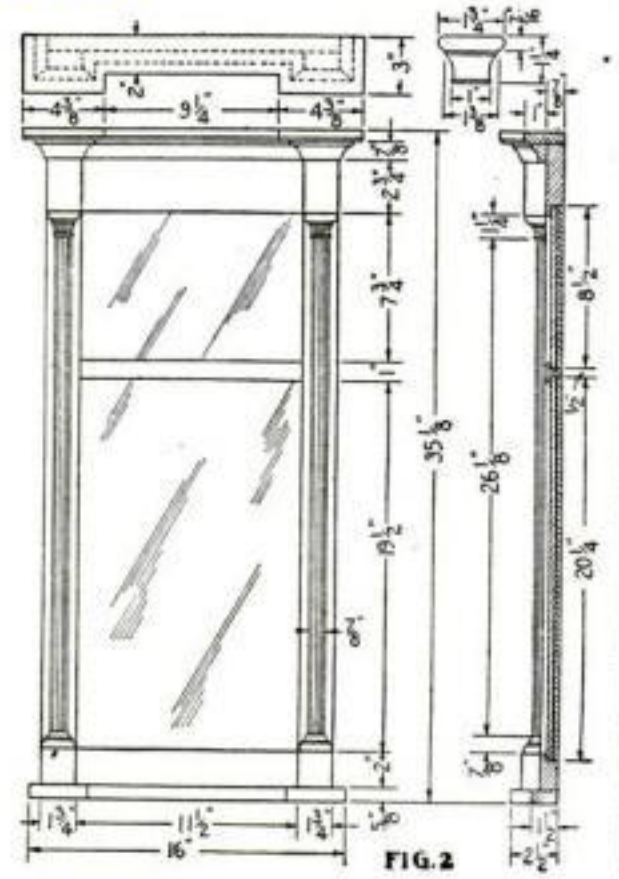
SOMETIMES it is desired to fit a turned column over a square corner as at *B*, Fig. 5. In this case a quarter section is sawed out of the solid piece from which the column is to be turned. On account of the waste in sawing, this piece cannot be used, but another piece of the proper dimensions is prepared and glued in its place with a piece of paper dividing the joint, as at *A*. When the turning has been completed, the glued piece can be easily removed by forcing the blade of a chisel into the joint, thereby causing the paper to split. The remainder of the paper and glue is now removed from the column, after which it may be glued in place.

Turned moldings, which are decorative and easy to make, should be of especial interest to amateur woodworkers who have difficulty in working out moldings by hand. The various steps in the procedure of turning moldings are illustrated in Fig. 6. Step 1 shows the end of a square piece of stock, to the sides of which four pieces of wood are glued. A piece of paper is placed between the joints, so that the finished strips of molding may be separated easily from the square stock.

It is very important to center the square piece accurately in the lathe; otherwise the four strips of molding will not be uniform in size. It is well to cut into the square piece near each end with a parting tool until the tool is in contact



How the stock is prepared for split work and how oval and irregular pieces are turned.



Split turnings in the form of reeded columns form the principal ornaments of this mirror.

with the wood all around. If it is found that the parting tool has cut deeper into one or two sides than into the others, these sides should be planed until the cut of the parting tool is uniform on all four sides.

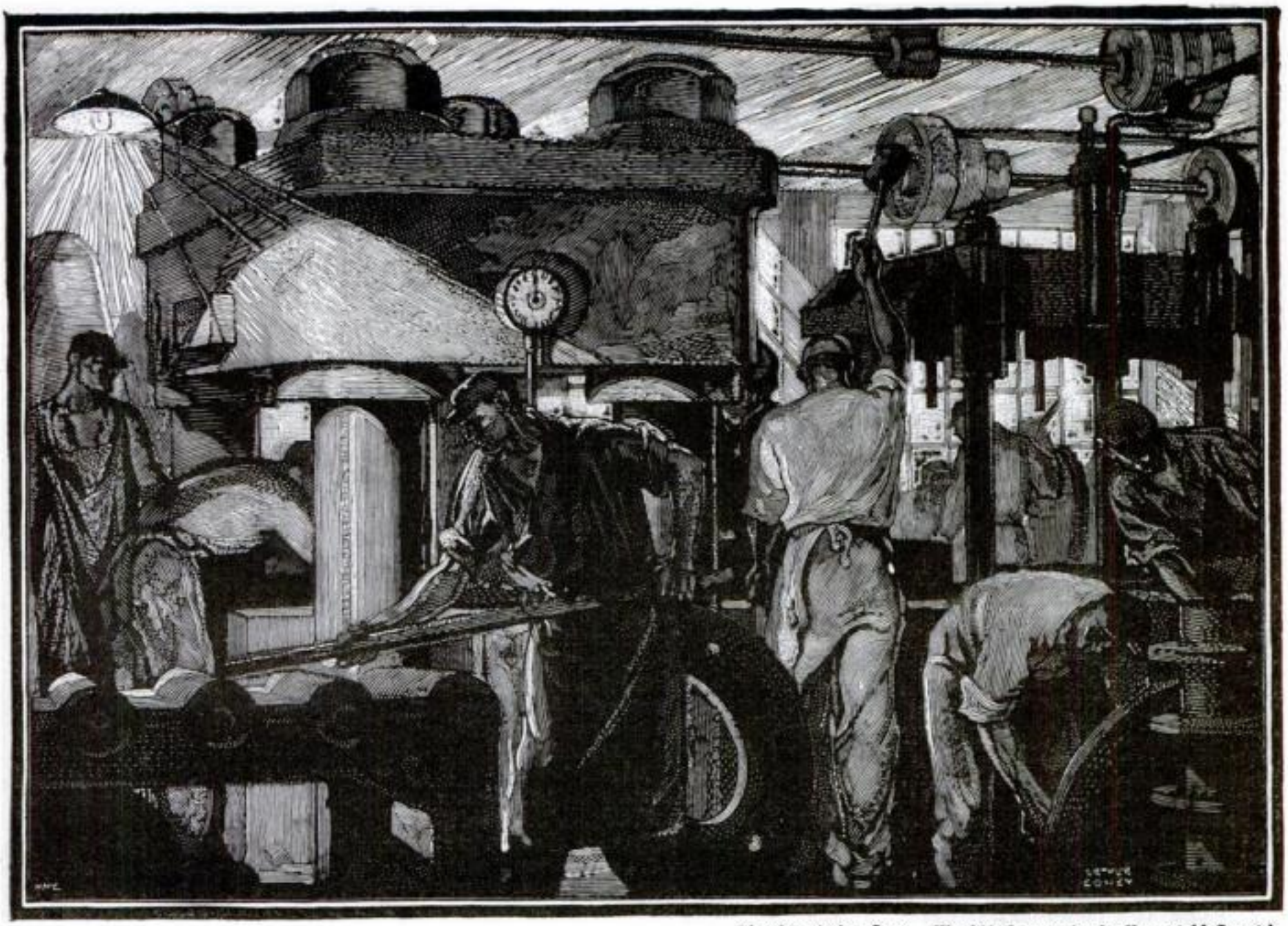
The stock is now rounded off as shown in step 2, after which the design of the molding is laid out and turned. The four strips of molding are then separated from the square core by forcing the blade of a thin, sharp chisel into the joint at either end. This causes the paper to split. The molding may be glued to a backing of any desired shape as shown in step 3.

THE radio table, Fig. 1, is a typical adaptation of Jacobean furniture design to modern needs. Although the piece is ornate in appearance, the construction is really simple.

First lay out and turn the four legs; then get out the side rails and stretchers and join them to the legs with mortise and tenon joints. The two sides are next connected by means of a central stretcher mortised into the side stretchers, a rear rail, and two front rails. The upper front rail is joined to the legs with a half-lap dovetail joint as shown on the plan view, and the lower rail or apron is joined to the legs with dowels as shown in the detail. This completes the framework.

The drawer front consists of a ½-in. piece to which four 1½ by 4 in. blocks, shaped as shown at *A* in the drawer front detail, are glued at each end, and a block *B*, ½ by 4 by 4 in., in the center. A suitable molding is fitted and glued around these blocks and along the top and bottom edges. The drawer is then constructed and fitted in place.

The split turning is applied to the front legs as shown, after which the top is made and screwed to (Continued on page 116)



Mural by Arthur Covey. Wood block engraving by Howard McCormick

Tiny grains of abrasive, a plastic organic bonding material, the application of heat and of tremendous power—thousands of pounds pressure. And one type of grinding wheel is formed—wheels for certain definite kinds of work. In direct contrast, wheels their equal in cutting efficiency but for different kinds of work take their form from pouring a semi-liquid mass into molds. With five bonding processes, three abrasives and hundreds of formulae, Norton wheels meet the world's widely varying requirements.

From practical experience comes the demand for a stronger or weaker bond, coarser or finer abrasive, or another type of abrasive, greater or lesser density. The slightest change in formula may produce the desired change in the wheel's cutting action. By these means must be met the exacting demands of industry for grinding its steels and irons and their many alloys, as well as softer metals and other materials.

The Covey mural in Norton Hall here reproduced presents one good reason for Norton success—a proper co-ordination of human effort and machinery.

NORTON COMPANY, WORCESTER, MASS.

NORTON

Grinding Wheels
Grinding Machines

Refractories-Floor
and Stair Tiles

Kalsomine Stippled Walls

How to Obtain Decorative Effects in Two or Three Tones at Low Cost

By F. N. VANDERWALKER

ARTISTIC and uncommonly interesting wall finishes are possible with kalsomine. In fact, it is much easier to obtain special decorative effects than to do a good job of plain coloring with kalsomine, although plain kalsomining is not by any means a difficult task.

Kalsomine is an economical material; a five-pound package will do an average 10 by 12 ft. bedroom at a cost of less than one dollar for material. The method of mixing and applying it and its advantages and disadvantages were explained in a previous article in the January, 1929, issue of POPULAR SCIENCE MONTHLY.

As many as two dozen tints and shades as well as white can be had in some of the better known brands. By adding any of the colors to the white you can produce other shades and tints, and you can intermix any of the colors.

It is best to use a standard kalsomine brush from 7 to 9 in. wide, or one of the Dutch kalsomine brushes, which is two or three times as thick. However, a first-class wall brush 4 in. wide can be used; the special 4-in. flat wall brushes called "water tools" are the best of this size.

New plaster to be kalsomined should be brushed down to remove any loose dust or sand. Any cracks or damaged places should be cut out with a putty knife to remove loose plaster and to make small cracks fairly straight. Large holes should be undercut with the putty knife or other tool. Soak the holes and cracks with water and then fill them with prepared patching plaster, which can be had in cartons from any paint or large hardware store; or submerge some plaster of Paris in water, take out a handful as large as an egg, knead it a little, and plug it into the holes and cracks. Smooth the plaster with a putty knife or a flat, softwood paddle. When dry, coat the patch of new plaster carefully with thin shellac.

Fig. 1. A sponge is used to tap the stippling color lightly and freely over the ground coat.

The glue size coat for smooth plaster walls should not be too strong—about 1 lb. of ground or flake glue to 1 gal. water.

Old kalsomined walls should be washed clean before a new coat is put on. Old wall paper must be removed by soaking it with water and scraping. Old painted walls, if they are clean and flat, are ready for kalsomine after the glue size coat. If some gloss is noted, the painted wall should be sandpapered a little with No. 1 paper before sizing. Where the old paint is very dirty or greasy, it should be washed with sal soda and water before sizing. Wallboard walls should have one or two coats of glue size before the kalsomine is applied.

(Continued on page 121)

Fig. 2. An attractive two-tone finish consisting of one plain and one stippled coat.

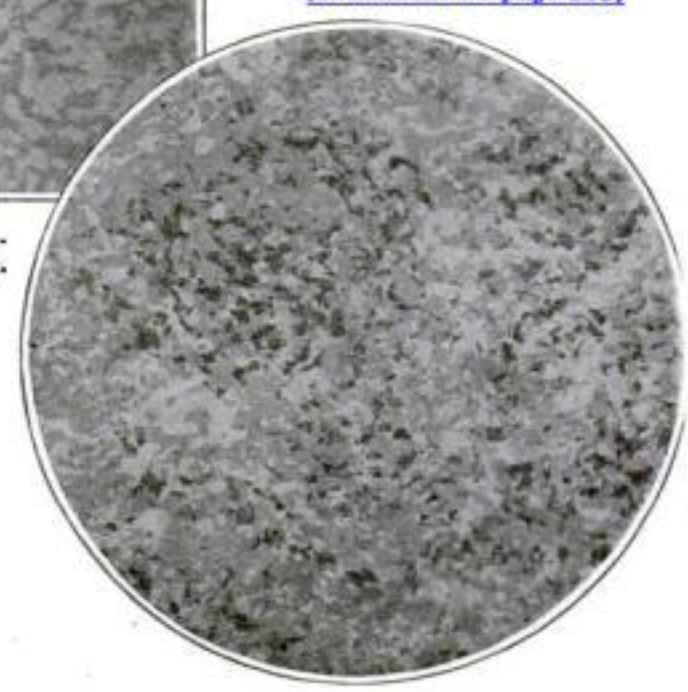
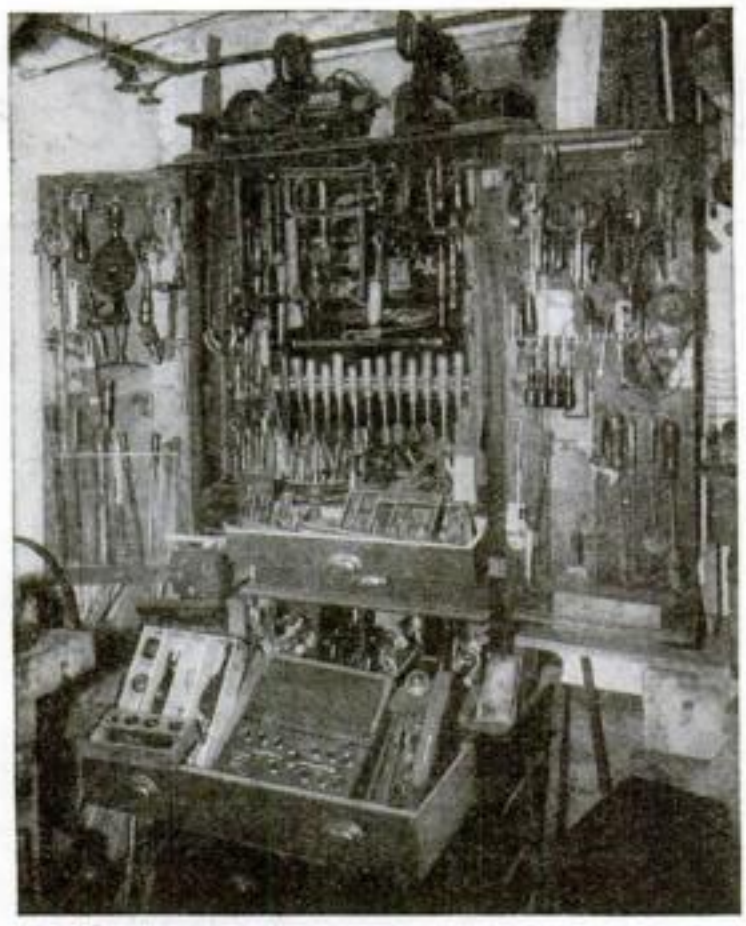


Fig. 3. A three-tone kalsomine effect obtained with light blue and old rose over a cream-colored ground.

Keeping a Shipshape Shop



A discarded washstand with a large cabinet on top forms a convenient storage place for tools in the homeworkshop.

WHEN my first set of tools outgrew the small cabinet which came with them, I made one of an old washstand such as can be bought (if there is none up in the attic) at a secondhand store for a song. This did for a while. Then came the idea of making a top for it like a kitchen cabinet.

The upper part is detachable for moving. There are two long compartments at the sides to hold saws, which stand in on their handles.

Wood chisels, carving tools, and bits are held in commercial tool racks. Hand vises and hand drills, with screw eyes in their jaws, and such tools as can have screw eyes in their handles without interfering with their usefulness, are hung on the doors. Toothbrush racks of two different styles bought in a ten-cent store hold many small socket wrenches and screw drivers. Other racks are made from wire and some from wood. In some cases the boxes which originally held tool sets such as auger bits, pipe dies, and socket wrenches were adapted for use merely by removing the lids.

The design for the frame of the top was carried out in the same style as the base. Four pieces 2 by 2 in. were cut 48 in. long. Two of them were plowed to the depth of ½ in. on one side; the other two were plowed the same way on the face and one side. Boards ½ in. thick were cut 10 in. long for the sides and 31½ in. for the back and were dropped into these grooves.

Two pieces 2 by 2 by 30½ in. connect the uprights in the back, and four pieces 2 by 2 by 9 in.—two for each side—form the top and bottom rails of the sides. All are fastened by means of dowels.

The top is ⅞ by 13 by 36 in. The bottom is set in. The supports for the drawers, which first were shelves (drawers being made later), were screwed to the sides in the recess between the uprights. The top doors and the one narrow horizontal door which covers the compartments where the planes are kept can be locked. This is good insurance against the loss or borrowing of tools in one's absence.—ADDISON T. MCCARRICK.

AMATEUR craftsmen and model makers often do not get as much pleasure out of their hobby as they might because they lack a convenient workbench. That, however, can be remedied easily, for it is possible to build at no great expense a bench that is ideal for use

Home workshop bench built from plans in POPULAR SCIENCE MONTHLY Blueprint No. 15.

in the home workshop. Such a bench is shown completely in POPULAR SCIENCE MONTHLY Blueprint No. 15 (see page 111).

With the aid of this blueprint George D. Wood, Jr., of Penn Yan, N. Y., built the bench illustrated. The cost was as follows: lumber complete, planed and cut to size, $13.65; lag screws, $1.08; four hinges, 15c; six drawer pulls, 50c; box lock, $1.25; wood screws, 15c; cupboard turn, 20c; nails, 3c; glue, 20c; high-grade quick-acting woodworkers' vise, $8; total, $25.21.

Other readers have built benches from the same plans at a still lower cost by cutting up their own lumber and economizing in the vise and fittings.

You don't have to be an expert to use Corona

By a Modern Girl

I HAD an interesting experience recently. I was down town shopping. "What beautiful colored typewriters!" I exclaimed. I had stopped beside an attractive counter display.

"They *are* beauties, aren't they?" replied the man behind the counter. "Wouldn't you like to try one?"

"Oh, no, thank you. I'm not expert enough. I never used a typewriter in my life."

The clerk laughed. "You don't have to be an expert to use Corona. Children in the first grade in school use them."

"How long does it take to learn?"

"You can learn the fundamentals in a few hours—that is, after you have read a helpful little book that is given free with every Corona."

That was three weeks ago. Now I have my own Corona. What a joy it is! I write all my letters on Corona. It seems actually easier than writing by hand—and it's much more fun. The clear-cut lines of type make my letters look neater than they ever did before. Many of my friends have complimented me on them.

. . .

This story is typical. Thousands of people are discovering that Corona is astonishingly easy to operate—that it is a wonderful convenience for office or home or travel—that it makes letter-writing lots of fun. Furthermore, the very features which enable beginners to write more easily, enable accomplished typists to *greatly increase their speed.*

You owe it to yourself to drop into a store where typewriters are sold and see Corona. The minute you lay eyes on it you will realize why a million people use it—why 30,000 Coronas were used in the World War—why more novelists, more newspaper men, more business men, more schools and colleges use Corona than all other portables put together.

For a small down payment you can take a beautiful new Corona home with you today. The balance may be paid in easy monthly installments. Don't neglect this opportunity. Don't let another day pass without doing something about it. Know *now* the joy of owning a sturdy, speedy, smooth-operating Corona—The World's Champion Portable.

An interesting illustrated booklet called "Corona Typewriters," which describes Corona in detail, and contains beautiful illustrations of the new color models, will be sent you upon request. No obligation. Simply mail the coupon.

CORONA IS THE WORLD'S CHAMPION PORTABLE ON 8 EXCLUSIVE POINTS

1. STRENGTH: *Strongest frame of any portable typewriter — solid one-piece aluminum, rigidly braced.*
2. SIMPLICITY: *Fewer parts than any other standard-keyboard typewriter.*
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4. EASY TO LEARN: *Corona design is the result of 20 years' study of the needs of beginners.*
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6. POPULARITY: *Corona has a million users. As many Coronas have been sold as all other portables combined.*
7. DURABILITY: *Coronas purchased 20 years ago are still giving satisfactory service.*
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613

Sharpening Your Auger Bits

With a Small File or Stone You Can Make Both Lips and Spurs Cut Almost Like New

By E. E. ERICSON

Fig. 1. How the lips are sharpened on the top.

Fig. 2. Filing the spur on the inside (right).

THE auger bit is one of the most delicate tools in the woodworker's kit. It must be of high-grade manufacture to begin with; even so, it will stand little abuse, and if it is not kept in first-class condition there is no pleasure in using it.

Cutting into nails with a bit is probably the most common cause of damage. In many cases, however, a bit that has apparently been ruined can be restored by proper treatment.

Fig. 3. Doctoring the screw point with an oilstone that has a thin edge.

Auger bits of various types may be had for different kinds of work, but the principal specification in which the average user is interested concerns the speed with which the bit is drawn into the wood. The boring speed depends upon the pitch of the thread of the screw point. In this regard auger bits usually are classified as slow screw, medium screw, and fast screw. For all ordinary work the medium screw is most satisfactory, but it is well to get advice from the tool dealer before making the purchase.

It is well to remember also that the original cost of an auger bit, or any other tool, is not the sole consideration, but that it is more important to obtain a tool that will "stand up" and give satisfactory service.

There are three principal parts of the auger bit (Fig. 5) (Continued on page 114)

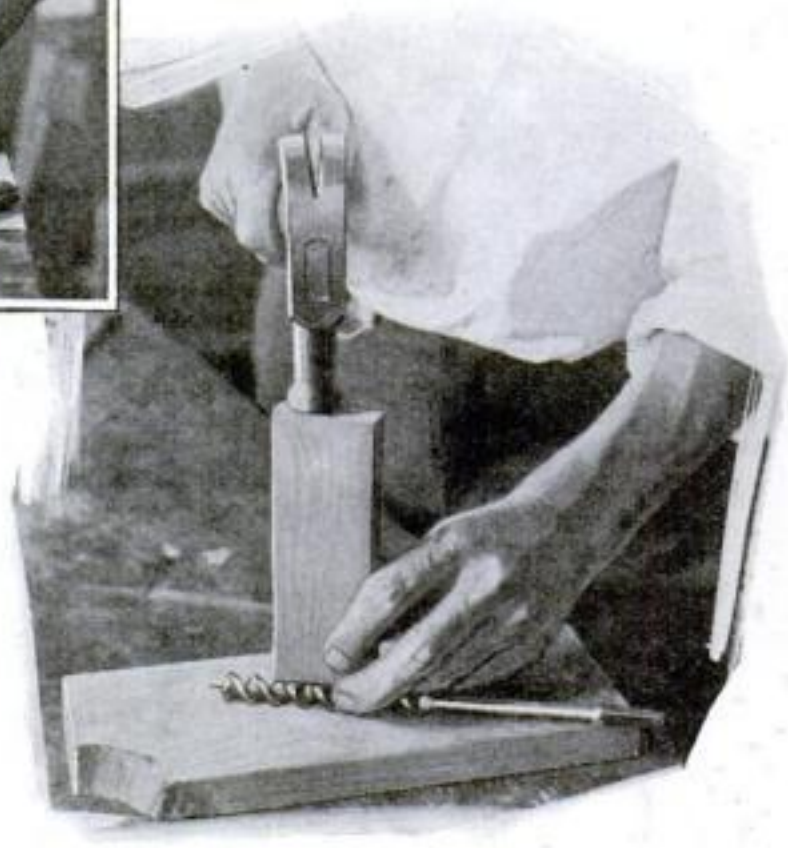
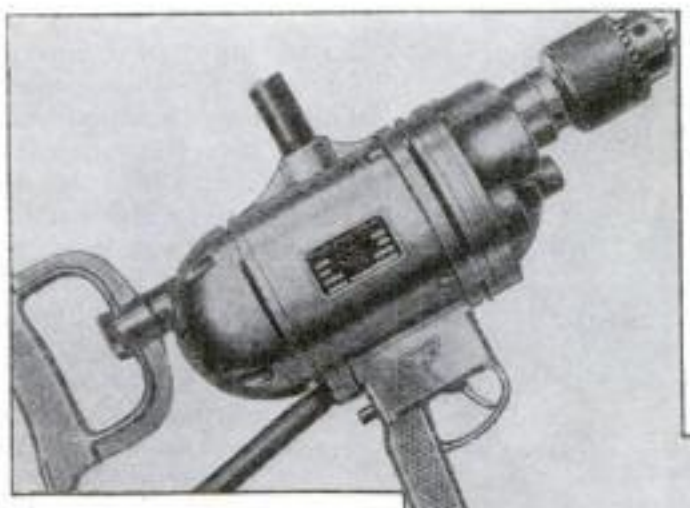


Fig. 4. To straighten a bit, lay it on a hardwood block and hammer another block heavily against it as shown.

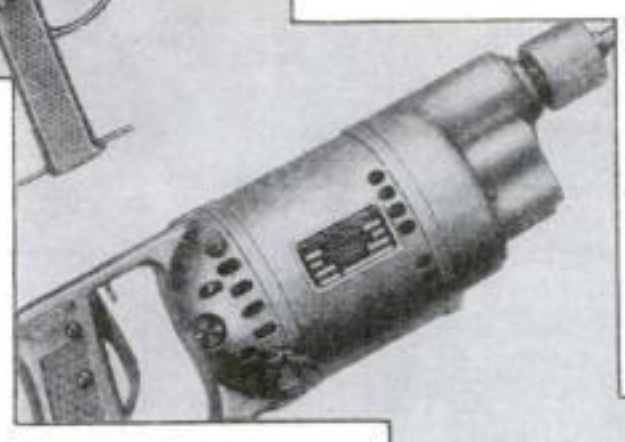
TEST AFTER TEST

. . . *in actual competition won by* Ⓢ

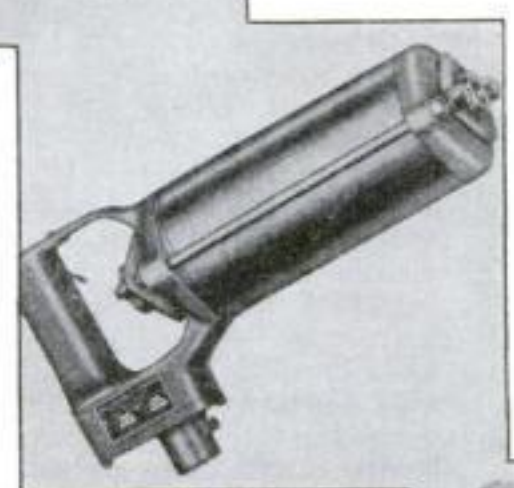
MILLERS FALLS ELECTRIC TOOLS



¾ Inch Drill No. 734



No. 1 Electric Screw Driver



Electric Hammer No. 1816

During the past year Millers Falls Electric Tools have been tested by thousands of prospective buyers on their own work. The tests have been made in actual competition with other electric tools. The results conclusively prove Millers Falls value. Thousands of electric tool users have been won over by Millers Falls performance, have become enthusiastic boosters for Millers Falls Electric Tools.

Here's what these tests show for MILLERS FALLS ELECTRIC TOOLS

POWER—Put up against the hardest kind of work, they continue to operate under full load without stalling.

VENTILATION—Load for load the lowest temperature rise, these tools reduce to a minimum the trouble and repairs caused by overheating.

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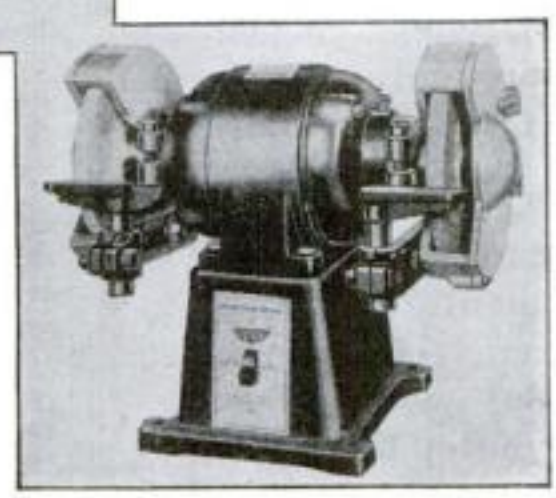

6 Inch Bench Grinder No. 506

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Ⓢ This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Magic with a Bit of Rope

You Cut a Length of Clothesline, Then Show It Whole—A Simple but Mystifying Illusion

35-34

By GEORGE S. GREENE

HERE is a trick easily prepared—really a small illusion—that is excellent for opening or closing a short entertainment in the parlor or on the amateur stage. It is a perplexing stunt savoring of India; in fact, a modification of the so-called East Indian rope trick that can be performed without an assistant.

You show a piece of clothesline rope and knot the ends together; then you cut the rope in several places and slowly cut away the knot. But, magically, the rope is again in one piece, and you *give it to the audience to examine.*

Obtain a yard or two of soft, pliable clothesline; cut off six inches from one end and save it. You will need also a small dress snap fastener—size No. 3-0 in the silver finish will do. Sew each half of the fastener on one end of the rope with white thread as in Fig. 2, taking care to wind the thread several times around the ends so that they will not fray or become lumpy. This gives a rope which can be snapped together at the ends, making a complete circle. The connection is not perceptible at a short distance.

To practice before performing, conceal the short piece of rope in the left hand, which also holds the long length unsnapped. Grasp the lower end of the latter with the right hand, bring it to the left hand, and snap the ends under cover of the hands. In the same movement, slip the short piece around the rope circle thus formed. While doing this, you must allow the snap-fastened joint to slip down to the bottom of the large loop. So far as the audience is concerned, you appear to be holding the length of the rope by the two ends with the left hand as in Fig. 3. Now tie the short piece around the longer, as if you are knotting the ends of the rope together.

Fig. 1. Cutting off the bottom of the loop, which is the part containing the snap fastener. The fake knot is at the top.

With the scissors make two cuts in the rope near the bottom of the loop, as in Fig. 1, thus removing what really are the two ends with the snap. Next, deliberately snip away the fake knot, being careful, of course, not to cut the rope proper.

As the climax of the illusion, show the rope whole and throw it to the spectators as a souvenir. Pick up the prepared rope ends from the floor with the other snippings and pocket them.

Caring for Garden Hose

GARDEN hose will last longer if it is drained thoroughly after use and rolled into a large rather than a small coil. The coil should be hung up in a cool place in the cellar. Many leaks can be repaired with so-called "cold patches" and a wrapping of friction tape. Badly defective parts can be cut away and the ends joined with metal hose menders.

Fig. 2. A dress snap fastener is sewed neatly and inconspicuously on the ends of the rope.

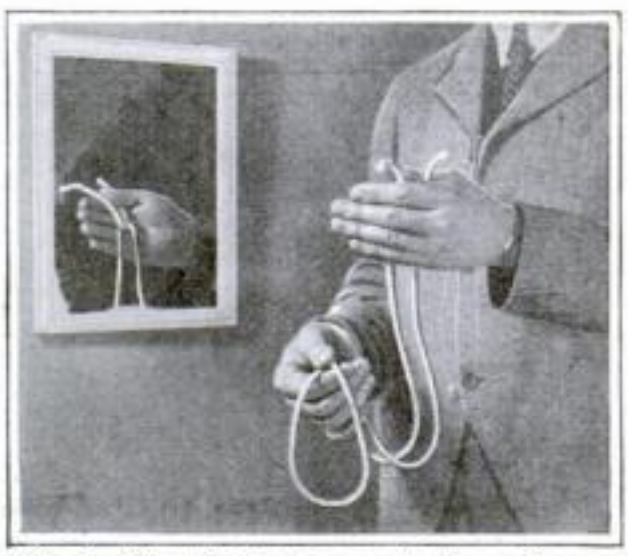
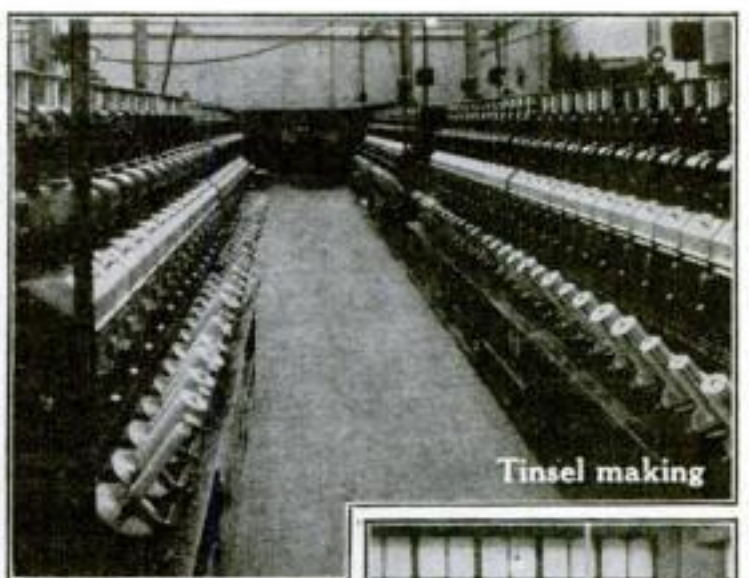


Fig. 3. How the rope appears to the audience. Note the fake ends as revealed in the mirror.

Only a telephone cord..

...but see what's behind it!



JUST a few feet of insulated wire leading from your telephone to the bell-box—but back of it is a long story of careful workmanship and alert inspection.

Cotton was grown and silk was spun to make that insulation. Wire was drawn into the finest tinsel, covered with the dyed threads, and twisted and braided. It was all done right, because the cord must be rugged enough to take a good many pinchings by desk drawers and still keep on playing its part in a telephone conversation.

This cord is a little thing. But it is just as important to good telephone service as is a fifty-position switchboard or a thousand mile cable. And Western Electric makes it with the same care.

Western Electric

MAKERS OF YOUR TELEPHONE

Latest Racing Yacht Model

(Continued from page 90)

show if the wood is dangerously thin. The shell or wall of the hull should be about ⅛ in. thick. Note, however, the pads which are left at the bottom for receiving the nuts of the keel bolts. A plastic wood composition is useful in repairing any defects in the hull, and it acts as a binder when applied over seams on the inside of the hull wherever there appears to be any defect in the gluing.

The next step is to glue lift *X* on the forward half. To save material, this may be in two pieces mitered on the center line forward. Then finish shaping the outside and gouging the inside.

To draw on the sheer line, lay out points with a pair of dividers on each station the distance of the sheer line from the water line (the glue line) between lifts *A* and *B*. Bend a thin strip of wood or a spline through these points and draw in the sheer line. Cut this line with a spokeshave or a small plane and test by eye to see that the curve is a fair one, without humps or hollows.

A wooden skeg just forward of the rudder should be fitted for the best racing results.

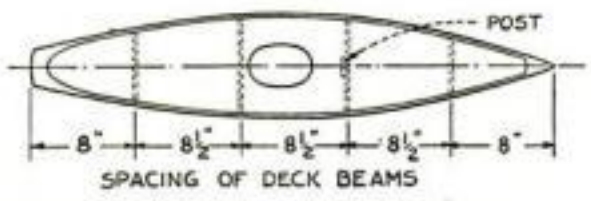
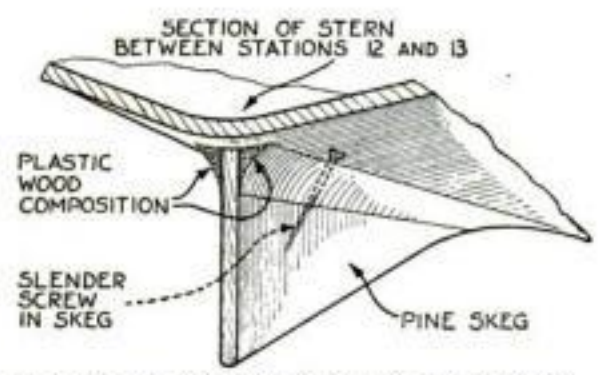


Diagram giving location of the four deck beams and the extra vertical support under the mast.

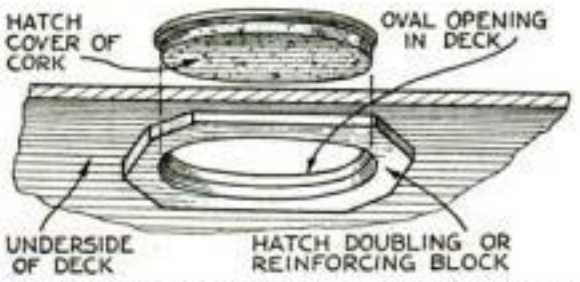
Younger or less skillful boys sometimes find it difficult to make a good job of this skeg, and it may be omitted if desired. If it is fitted, this should be done next. It is fastened to the hull with glue and long, thin brass screws from the inside, as shown below. The skeg is "streamlined" and given additional stiffness by a heavy plastic wood fillet. The weight of the hull should now be about 1.6 lbs.

Four ⅜ by 1 in. pine deck beams cut to the proper camber curve are next secured in place by means of brads and glue. They are located as shown below. A support ⅛ by ¾ in. is fitted from the deck beam to the shell bottom under the mast to take the pressure of the mast at that point.

The interior of the hull should be painted



The pine skeg is glued, held with one or more thin screws, and reinforced with wood paste.



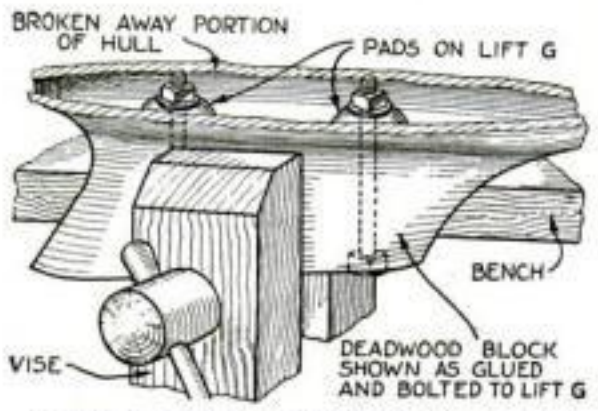
How the hatch cover is made and the deck is reinforced underneath at the hatch opening.

How cardboard templates may be used if necessary to aid in shaping the hull accurately.

with two coats of white lead paint before fitting the deck. The deck is made of one piece of ⅛-in. clear white pine or mahogany. It is advisable to cut out the deck to the shape of the hull first, leaving it about ⅛ in. oversize all around for trimming after it has been fastened down. If the deck is to be plank-marked, the necessary lines should be drawn on it with a hard pencil before it is put in place.

A round or oval shaped hatch opening for bailing out any water and for airing the inside should be cut in the deck. A ⅛ in. thick doubling or reinforcing piece should be fitted under the deck around the opening as shown above. A simple hatch cover may be made of two pieces of wood glued together; or better, a piece of mahogany or walnut for the top and a piece of cork to fit snugly in the opening. The underside of the deck should be painted with two coats to prevent its warping when wet.

The deck is fastened to the hull with glue and fine brass screws or brads. The brads should be placed close to the outside edge so as to be covered by the rail and slanted in so as not to



Partial view of the rough hull showing how it is held in the vise by means of the deadwood.

come through the outside of the hull, especially fore and aft where the hull slopes in. It should be noted here that unless the oval hatch in the deck is of the size indicated on the plans (sufficiently large to permit access of a hand for tightening the keel bolt nuts inside the hull), it will be necessary to attach the lead keel before the deck is fastened down.

The model next requires the ⅛ in. thick mahogany or walnut rail, breasthook, and stern trim, which are fastened in place with fine brads and glue. However, do not fasten the rail where the chain plates are to go (see the blueprints), because the chain plates must be slipped under it.

As the next step, the entire hull should be smoothed with fine sandpaper and the surface put in as perfect condition as possible.

We are now ready to make the lead keel. This and the directions for the painting or other finish, the construction of the fittings, and the rigging and sailmaking will be discussed in the next issue of this magazine.

Blueprints for Your Home Workshop

OUR blueprints can be obtained for 25 cents a sheet. In some cases there are two or three sheets to one subject. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine in which the project was described in detail, it can be had for 25 cents additional so long as copies are available. Other subjects besides those below are to be had; send a stamped envelope for the complete list.

Popular Science Monthly,
250 Fourth Avenue, New York

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....dollars.....cents.

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Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

ACETONE, turpentine, carbon tetrachloride, or kerosene, alone or in combination with each other, usually will solve the problem of removing oil in such cases as are likely to arise in the home workshop. When, however, the old oil must be removed from an oilstone that will no longer cut, such solvents cannot be used. Heat the oilstone slightly and apply a paste of whiting (precipitated chalk) and water. When the paste has absorbed the oil, scratch off the whiting, reheat the stone, and apply a fresh batch of whiting. Repeat until no more oil is absorbed by the chalk.

Soft rubber articles that have been hardened can sometimes be resoftened by placing them in a solution of one part ammonia and two parts of water.

Rubber articles should be washed only with mild soap, and all of the soap must be thoroughly rinsed away with running water. Never use alcohol, chloroform, gasoline, turpentine, or benzine.

Match scratches on woodwork often can be removed by rubbing them with the slice of a lemon, then with whiting, and finally with a moist, soapy cloth. Shellac stains can be removed with washing soda. Borax also will dissolve shellac.

An ink for writing on glass can be made by dissolving shellac flakes in borax dissolved in water and adding a dye to color. Transparent colors used for photographic work give good results, and aluminum or other metal powders can be used.

To dissolve salts of all kinds rapidly, place them in a piece of clean cloth and suspend in a jar or bottle filled with water or other liquid. The cloth must be so adjusted that the crystals are just below the surface of the liquid. No shaking or heating is required.

The removal of a volatile solvent is best accomplished by placing the container in a pot of boiling water, or, where there is danger of fire, in a flat, open dish and exposing it to the air.

The adulteration of beeswax with mineral wax or with paraffin can be detected by placing a small piece of the suspected wax in a test tube and cautiously pouring fuming sulphuric acid into it until half full. On being heated, the beeswax will dissolve, and the mineral wax and paraffin will float on the surface when the acid cools.—ERNEST BADE.

IN REMOVING the worn upholstery from the seat cushion of a large rocker, it was discovered that the ends of the springs were loose and had cut holes through the burlap covering and the upholstery. To protect the new upholstery the loose ends were each fastened down with six layers of friction tape.—R. C. B.

A Stool to Please Any Small Child

By F. CLARKE HUGHES

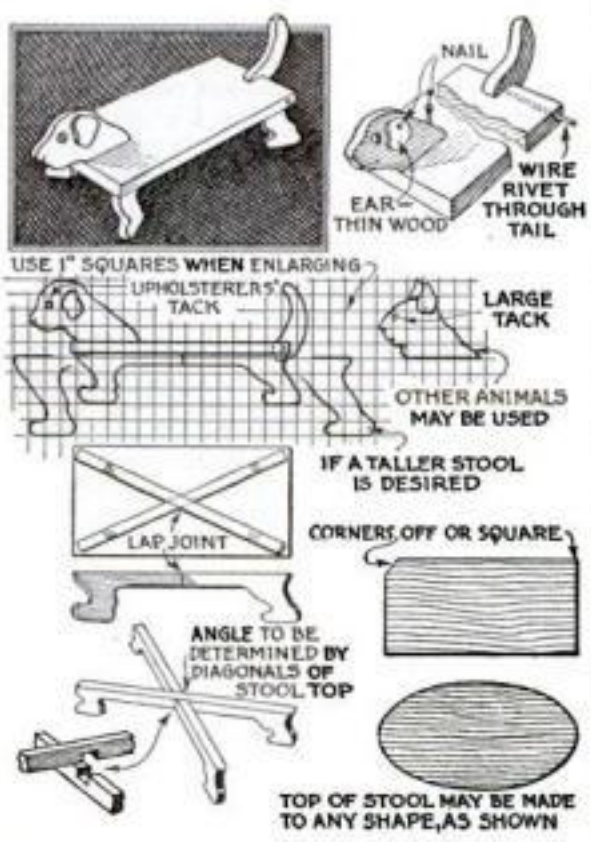
THIS doggy or kitty stool is for the small child of the house. A good size for the top is 7 in. wide and 14 in. long, but the design may be enlarged to any extent merely by varying the size of the squares.

After the parts have been drawn full size, they may be cut from ¾-in. stock

When a child begins to use a standard size wash bowl, a low stool is a real convenience.

with a turning saw, a keyhole saw, an ordinary coping saw, or a motor-driven fret or band saw, if available. The legs are cut in two sections and joined by means of a half-lap joint, which, if assembled carefully, will give a strong type of construction. They are screwed to the underside of the stool top. The head and tail are fastened as shown, the tail being free to move up and down.

Other animals may be used equally well for the motive or general design, and the problem offers many possibilities.



Suggestions for several stools, the size of which should be adapted to the little user.

Sharpening Auger Bits

(Continued from page 106)

that may receive injury through contact with foreign substances in the wood—(1) the screw point (the screw that feeds the bit); (2) the lips (horizontal cutting surfaces); (3) the spurs (vertical cutting edges). All of these can be reconditioned, provided the damage done to them has not been too great.

For sharpening auger bits, either a file or a small sharpening stone may be used. A suitable file is one about 4 in. long, very fine cut ("dead smooth"), and half round in shape. It is better, however, to use a special auger bit file (Fig. 5), which can be obtained in any large hardware store. Such a file is made with "safe" edges adjacent to the cutting surfaces, and there is no danger of filing in the wrong place.

The lips are filed or sharpened with a stone on the top side, the bit being held in the position indicated in Fig. 1. The edge must be kept thin, and filing should not be carried beyond the point where a fine wire edge or burr appears. If a small sharpening stone is available, it should be used for a very light stroke or two on the underside of the lip in order to remove the wire edge; if no stone is at hand, the file may be used for the same purpose. For this delicate operation, the bit is turned with the spurs upward and laid against the edge of the workbench. Care must be taken not to file too much and to follow the original surfaces.

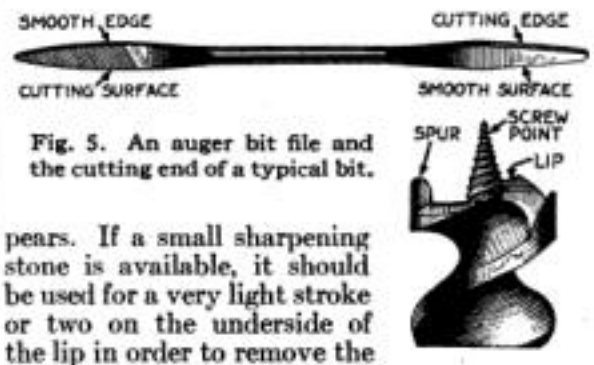


Fig. 5. An auger bit file and the cutting end of a typical bit.

The spurs are sharpened with the bit in the left hand and held against the edge of the bench as shown in Fig. 2. It should be kept in mind that the spurs must be long enough to cut deeper into the wood than the lips when the bit is in operation, hence no wasteful strokes should be made at this point. If they are worn too short, the lips probably can be filed back in order to relieve the difficulty. Needless to say, all filing on the spurs must take place on the inside, except the smoothing up or removing the burr, as previously described.

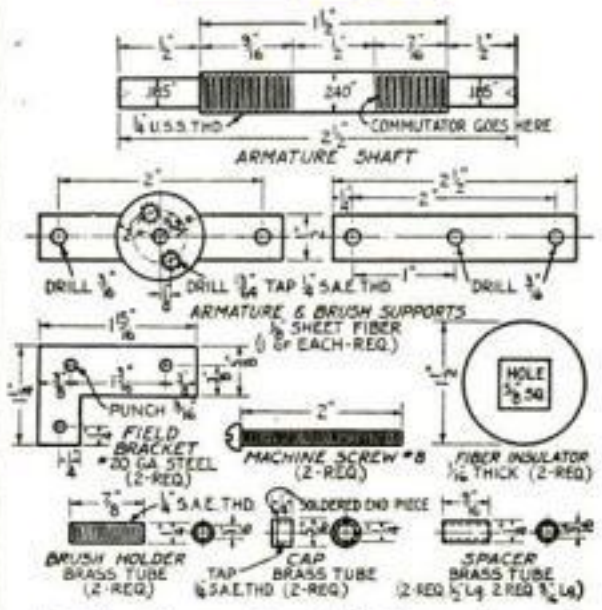
Sometimes, after striking a nail at a certain angle, the spurs are bent inward very decidedly. In such cases, instead of removing all the distorted metal with the file and thus losing a large part of the nibs, it is possible to reshape the bit by bending the point back into position with a pair of small pliers. In doing this care must be taken not to break off any part. After the tip is put into position, it is sharpened in the usual way.

The screw point is probably the most difficult part to put into condition after it has been injured. Patient work with a special oilstone having a very thin edge as shown in Fig. 3 will usually give satisfactory results. If considerable injury has been received at this point, the bit may afterwards require a slight pressure to assist the screw in feeding; but since that requirement can be met with in all ordinary work, its efficiency is not materially reduced.

An auger bit which has been bent out of shape may be straightened as in Fig. 4. A block of wood, preferably some hard variety, is used as a support, and a wooden block, held on end, makes contact from above. A smooth-faced wooden mallet may take the place of both hammer and block. A good way to test an auger bit for straightness is to lay it on a straight surface and revolve it slowly while watching for irregularity in the space between the bit and the surface at various points.

Building a Motor

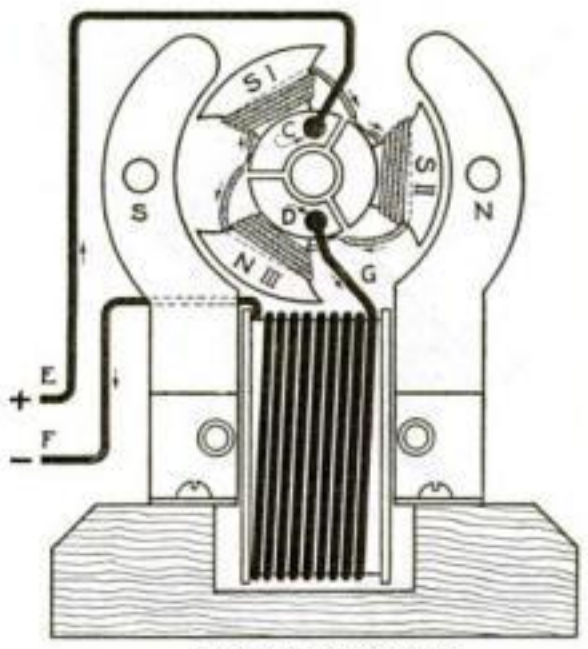
(Continued from page 84)



Details of the armature shaft, the armature and brush supports, and other necessary small parts.

number of turns of No. 20 magnet wire to fill the space to the top of the circular fiber insulators.

Next assemble the frame and brush holders. Slip the armature into place and fasten the armature brush supports and spacers by means of two machine screws and nuts. Adjust the armature for clearance by putting a piece of fiber or cardboard of the required thickness between the field and one pole of the armature. Screw the brush holders until they are 1/16 in. away from the commutator. Put the brushes and springs in place and screw on the caps. Fasten the motor to the wood base, connecting the wires as shown in the schematic diagram. Terminal wires marked *E* and *F* are leads to the battery.



WIRING DIAGRAM

How the motor is wired. *C* and *D* represent the brushes; *N* and *S*, the north and south poles.

Sealing Varnish Cans

ORDINARY varnish cans of the rectangular type are often hard to seal properly after part of the varnish has been used and the remainder is to be left in the can awaiting future use. As varnish becomes thick and useless when exposed to the air for any great length of time, it is essential to see that the can is sealed tightly. One way to do that is to leave the original cover untouched and remove whatever varnish is needed for the job in hand by the simple expedient of punching two 1/8-in. holes in diagonally opposite corners of the top. The varnish then can be poured like milk from an evaporated milk can, and the holes afterwards can be sealed air-tight with two quickly-whittled wooden plugs.—S. W. SULLIVAN.

Fancywork for Your Lathe

(Continued from page 100)

the rails by means of cleats. Two pear-shaped drawer pulls (and a lock, if desired) should be applied and then removed until the table has been sandpapered and finished. Any good cabinet wood is suitable for this table.

In the mirror frame, Fig. 2, split turnings again form the decoration. The frame itself consists of two sidepieces, a toppiece, a bottom piece, and a narrow central piece. These pieces, which are all rabbeted to receive the glass and back, may be joined with dowels.

Bill of Materials

No. Pcs.	Part	T.	W.	L.
	For Radio Table			
4	Legs	1¾	1¾	28¼
2	Side rails	¾	5	12
2	Side stretchers	¾	1½	12
1	Rear rail	¾	5	26
1	Front rail	¾	1½	26
1	Apron	¾	2¾	24½
1	Center stretcher	¾	1½	26½
1	Drawer front	½	4	24½
1	Drawer front block	½	4	4
2	Drawer front blocks	½	1½	4
1	Molding	½	⅝	84
2	Drawer sides	½	4	12
1	Drawer back	½	3¼	24
1	Drawer bottom	¼	12	24
2	Split turnings	1½	1	6⅛
1	Top	¾	18	36
2	Drawer pulls			
1	Lock with escutcheon			
	For Mirror			
2	Sides for frame	⅞	1¾	33⅞
1	Top for frame	⅞	3⅝	11½
1	Bottom for frame	⅞	2	11½
1	Center for frame	⅞	1	11½
2	Lower column blocks	1	2	2
2	Upper column blocks	1	2	3⅝
2	Column caps	⅞	1¾	1¾
2	Column bases	⅞	1¾	⅞
2	Columns	⅞	⅞	26⅛
1	Top	⅝	3	18
1	Bottom	⅝	2½	16
1	Back	¼	8½	12¼
1	Back	¼	20¼	12¼
1	Molding	½	¾	24
1	Mirror	¼	8½	12¼
1	Mirror	¼	20¼	12¼

All dimensions are inches.

After being glued, the frame is planed level and smooth.

The two half columns then are made and glued in place. Each column consists of the reeded central part, two turned caps, and two rectangular blocks. The columns may be turned in a single piece or they may be made in several parts; that is, the rectangular blocks, the caps, the bases, and the central part may be made separately, fitted together, and glued to the sides of the frame. A simple molding is now made and fitted around the top part of the frame as shown in the plan view. A top and a bottom piece screwed or doweled in place complete the frame. A turned molding may be used instead of the one shown, if the toppiece is made plain like the bottom piece. The process of reeding will be explained in a following article.

It is advisable to place a piece of paper between the mirror and the backing. The backing itself is of plywood. If the frame is constructed of thinner stock or the rabbet is made more shallow, the backing may be made in one piece and screwed to the outside of the frame.

A knowledge of oval turning occasionally may be found useful, although it is hardly worth while to turn such things as a hammer handle, which can be bought so cheaply. As a matter of interest, however, the process deserves description. The shape of the oval is laid out on the end of a piece of stock of slightly larger dimensions (see step 1, Fig. 7). The larger center line, that is, the longest axis of the oval, is marked all around the stock as shown. The other center line is then marked and the centers determined and laid out on both ends. Small holes should be bored in the ends at these points.

(Continued on page 117)

A definite program for getting ahead financially will be found on page four of this issue.

Fancywork for Your Lathe

(Continued from page 116)

Mount the stock in the lathe, using a pair of centers nearest to the operator, as in step 2. Run the lathe at slow speed and turn the stock until the center lines marked along it are reached. Stop the lathe frequently and inspect the work, as it is impossible to take any caliper measurements.

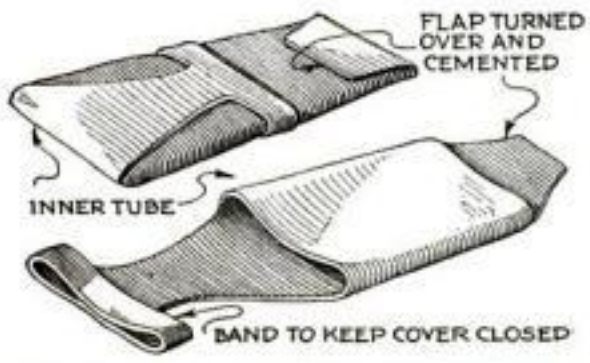
Next mount the stock on the pair of centers farthest from the operator and turn as before (step 3). The stock is finally mounted on the true centers and the sharp points cut away (step 4); then it is sanded until it is smooth.

Pieces that are not straight, such as the rear leg of a chair, may be turned as shown in Fig. 8. A piece of wood is glued at one end of the piece so that there will be the same weight of material on each side of the centers. An uneven weight would cause excessive vibration and make the turning difficult. The block is removed after the turning is completed.

The next article, which will conclude the series, will deal with reeding and spiral turning.

Waterproof Envelope Made from Old Inner Tube

TO PROTECT drawings, letters, and other papers from dampness, an envelope can be made from an old inner tube, as shown below. The tube is cut to the pattern indicated, and the lower end or flap of the envelope is stuck fast with rubber cement. The rubber band



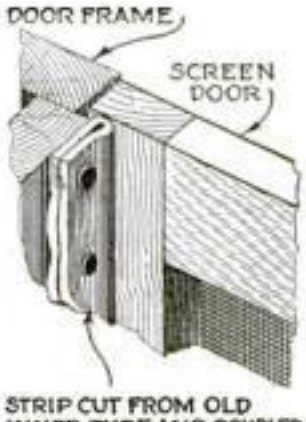
A rubber case for preserving papers from dampness. It is cut from a discarded inner tube.

left at the upper end of the envelope is passed over the lower end to keep the contents in place.

Outdoor men—surveyors, civil engineers, builders, hunters, tourists—will find one of these envelopes a thoroughly damp proof case for papers.

Silencing a Screen Door with Rubber Bumper

MANY devices are sold to prevent the slamming of screen doors, but reasonably good results can be obtained at no cost by applying a strip of rubber as shown.



Rubber silencer for a noisy screen door.

Cut an old inner tube at the valve and slit it lengthwise as nearly straight as possible. Open it and tack it flat on the floor. Lay a strip of wood 2½ or 3 in. wide on it, and with a sharp, wet knife, cut the rubber along both edges of this straightedge. In tacking the rubber to the door, allow the rounded edge to project about 3/16 in. and use plenty of tacks.—C. A. K.

Making a Family Motor Boat

(*Continued from page 77*)

you may also take off the proper bevel made by the planking at each frame so that you can rabbet the keel accordingly. A small template at each station will aid in cutting the rabbet.

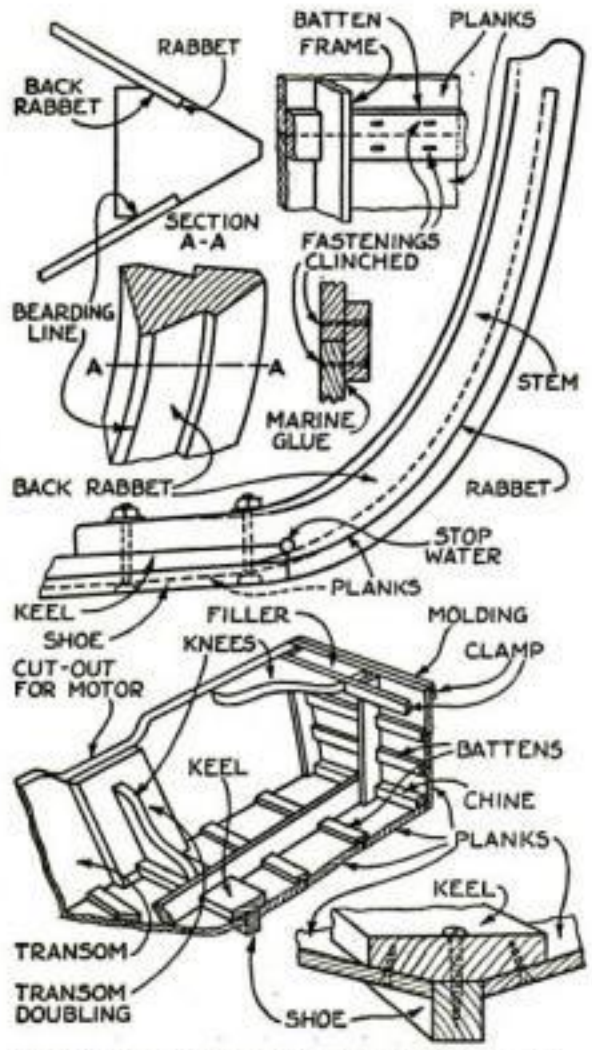
In setting the frames up according to their height and location, remember that all dimensions are given to the center of the frame; that is, the bottom members of each frame are on the after side of the station line, while the side members are on the forward side. In joining bottom and side frames, use copper rivets instead of screws, to insure durable fastenings.

The necessary tools are hammer, crosscut saw, smoothing plane, extension rule, bevel, square, plumb line, riveting hammer, bit brace and several sizes of bits, and a number of C-clamps.

Lay out the stem full size on a piece of heavy paper. It must be from a piece of oak 20 in. wide, 1¾ in. thick at the head, and 3 in. where it joins the keel. If possible, it should be a natural crook; next best is a piece of steam-bent white oak; third in order is a piece of white oak sawed to shape. A ship knee, if procurable, is just the thing.

The sketches below illustrate the stem in process, and also the proper way to cut the rabbet so that the planking makes a tight fit into it. The stem must be scarfed at its lower end to take the forward end of the keel properly as shown. For this fastening, use brass carriage bolts with their heads sunk in counterbores and plugged, as the joint must be flush.

The keel may now be worked into shape. In this instance, to avoid the somewhat difficult job of rabbeting a one-piece keel, it is in built-up form and consists of the keel proper and the shoe. The edges of the keel are beveled to the right angle to receive the planking; or after the keel and shoe are assembled, a regular rabbet plane may be used just as in getting out a one-piece keel. The two pieces should be made up in paint or in marine glue, and securely fastened with heavy screws.



Details of the stem, keel, and seam-batten construction, and a sketch of the transom and knees.

Specifications

Length over all	15 ft. 11 in.
Beam	48 in.
Depth, stern	16 in.
Depth, amidships	16 in.
Depth, stem	22 in.

Keel: Sided 2¾ in., molded ⅞ in., spruce or oak.
Shoe: Sided ⅞ in., molded 1 in., spruce or oak.
Stem: Sided 2 in., molded 1¾ in. at head, 3 in. at connection to keel, oak.
Breasthook: 1 by 7 in. oak.
Transom: ¾-in. oak or mahogany.
Transom doubling: ¾-in. oak or mahogany.
Transom knee, vertical: 1¼ by 9 by 10 in. oak.
Transom knees at corners: 1 by 9 by 10 in. oak.
Frames: Side—sided ⅝ in., molded 1¼ in. at heads, 2½ in. at heels, spruce; bottom—sided ⅝ in., molded 2 in. at chine, 2½ in. at keel, spruce. Frames spaced on 15-in. centers from after perpendicular.
Seam battens: ⅜ by 1½ in. spruce.
Planking: Bottom and sides, ⅜-in. white cedar or mahogany.
Clamp: ⅝ by 1⅜ in. spruce.
Molding: ½ by 1 in. oak or mahogany.
Deck: ¼-in. mahogany, if varnished.
Deck beams: Sided ½ in., molded 1¼ in. at center, 1 in. at side.
Cowl: ¼-in. mahogany.
Seats: ¾ by 2 in. slat construction.
Floor boards: ⅜ by 3 in. spruce.

The transom may be of one piece or built up. If built up of two pieces, be sure to dowel it together securely. Fasten the transom frame into place so that you will have a double fastening for the plank ends. Secure the vertical knee after putting on the transom doubling, and then you are ready to assemble the backbone of your boat—keel, stem, and transom.

Now proceed with the setting up of the forms on their proper stations and fasten them firmly. I shall leave the method of fastening them to your own ingenuity, but be sure that you work from an established reference line, either the top of the timber, which is best, or the level floor. Brace the frames on each side to the floor, and in a fore and aft direction so that they set square and plumb.

Lay the assembled backbone on top of the frames. If the notches have been cut properly, the keel should fit into them nicely. Plumb and fasten the stem in place, and likewise brace the transom at its proper angle.

Cut the notches for the chine pieces and carefully fit them in place, securely screwing them to the frames with ¾-in. No. 10 screws. Notch all frames for the seam battens.

Before you start planking, check up on everything—the positions of the frames, their heights, the fairness of the keel, the chine and batten edges. Your eye should tell you much at this stage, for even a very small discrepancy may be seen in an unfair line or an out-of-plumb frame.

Start planking with the sheer plank, that is, the top plank when the boat is right side up, and put on first one side and then the other, doing this alternately so that there will be no danger of forcing the boat out of shape. The planks (three to a side) must be sufficiently long and wide to leave plenty of material for trimming the ends and edges to proper shape and size. Use plenty of marine glue in making up all seams and other joints.

Secure the planking to the frames and along the keel with 1-in. No. 8 screws, and use the same at the chine piece. In fastening the planking to the battens, use copper clinch nails, clinched to the inside of the battens and spaced not more than 2 in. apart. Screws should always be drilled for, and sometimes it is well to drill for clinch nails, always with a smaller drill than the size of fastening. Brass screws and copper (*Continued on page 119*)

A Family Motor Boat

(Continued from page 118)

nails not only make a better job, but the difference in cost over galvanized is not worth mentioning on a boat of this size. Plank seams should be carefully fitted, as no calking is used in the seam-batten construction.

When the planking has been finished, the excess glue should be scraped off the seams and the entire outside of the hull gone over and smoothed nicely with sandpaper. If it is to be painted, apply a coat of primer, otherwise give the hull a first coat of varnish. Then turn the hull over, place it on a couple of horses, and you are ready to fit in the clamps, stern knees, breasthook, and deck beams, and deck her over to any extent desired. In fitting the transom side knees, use a filler piece between clamp and planking, and fasten all together with a through fastening, that is, through planking, frame, and clamp. Do likewise in fitting the breasthook.

A DECK of some kind is a great convenience in a family boat, and as the lightness is not of prime importance in this case, let us put on either the deck shown in the drawings or one extending farther back, with perhaps a covering board or side deck 3 or 4 in. wide.

If the longer deck is used, beams $\frac{5}{8}$ in. by 2 in. may be gotten out on a crown of 3 in. in 7 ft. and fastened at the ends of each of the frames. A light wood decking may be laid over the beams and fastened to them. The deck may be canvas-covered, or the seams may be filled and finished bright. A straight or curved combing may be put in, or the popular amidship's deck may be added, thus dividing the boat into two cockpits and also serving to strengthen the hull. In all this the builder's taste and ideas will govern.

Floor boards and seats may now be fitted. These may be of the grating type with spaces between the boards. See that floor board sections are made easily removable and not too light. Lazybacks for the seats are an added comfort, and the seats and backs may be made of the right sizes to accommodate some of the standard life-preserver cushions.

When the hull has been finished, it may be thoroughly cleaned out and either painted or varnished. Remember that paint will not stick to marine glue, so the glue should either be cleaned off or shellacked over. For a painted boat my favorite combination is a green bottom, white topsides, and a buff deck. A pleasing combination is to paint the bottom and sides, and varnish the deck, molding, seats, and the like. An all-varnished boat of mahogany is always a pleasing sight.

What is the best motor to use with this boat? Any of the well-known class B or C motors will give satisfaction. It is just a matter of how much speed you want. The hull will perform satisfactorily with any of the motors large enough to drive her to planing speed, and that means better than fifteen miles an hour.

If the builder wishes, he may fit the hull with a steering wheel with suitable throttle connections, so that the motor can be controlled from the forward seat. He may add a windshield, flagstaff, and lights, and he should certainly carry a small anchor, a couple of fenders, a short boat hook, and a pair of oars or a paddle.

Since your boat is under 16 ft., she need not be registered, but you must, to comply with the law, carry a life preserver for each person. Approved cushions are excellent substitutes. You must have a mouth whistle capable of producing a blast of two seconds' duration and being heard for half a mile. You are required to have an approved type of fire extinguisher and two copies of the *Pilot Rules* (obtainable free from the U. S. Collector of Customs for your district). When running after sundown you are required to carry a combination green and red light forward, and aft a white light that shows around the horizon.

Old Bill Buys a Welder

(Continued from page 94)

factory did was to get a screen made so that the other men in the shop would be shielded from the glare of the electric arc, which is detrimental to eyes unless they are protected with dark glasses. This screen was made of four panels of canvas about 6 by 8 ft., mounted on pipe frames. The canvas was painted with aluminum paint to prevent it from burning so readily.

When all was in readiness, Old Bill, the instructor, and one of the shop men went into the inclosure to tackle the first job—a pipe manifold.

"The preparation of parts for welding is more important with arc welding than with torch welding," the instructor told his pupil. "The scarfs should be carefully made and clean. If they have been made with a cutting torch, they should be chipped or ground to remove the slight film of scale that is left. If they are rusty, the rust should be brushed off before any welding is attempted. For a butt weld, the ends should be scarfed at about forty-five degrees, as for torch welding, and uniform throughout the length of the weld. The reason for this last is that electric welding is wholly a filling-in process, without any melting, in the general sense of the word, and you should endeavor to have as little of it to do as possible."

THE instructor demonstrated the arrangement of the work and the electrode, as in Fig. 1. He told what voltages and currents to use for work of different sizes, and which of various electrodes to select. Then he showed several kinds of joints, as in Fig. 2.

"The strongest joint for tension is the butt weld," he said. "If properly made and reinforced, this weld is stronger than the plate in which it is made. For thin plates—say up to one quarter inch—the single bevel is the one to use, but for thicker plates the double bevel is better, and in addition is more economical, for there is less metal to fill in. Where a butt weld cannot be used, we have the lap welds."

Old Bill had been an attentive listener. "We have been making some flanged tanks, like those you saw near the door," he said. "I thought that we would gain time on them if they were welded."

"YOU would," the instructor replied emphatically. "That is just the sort of job where welding is well worth while. Now you are making them like this—" He drew a sketch on the bench like the right-hand view of Fig. 3. "You must bend the angle flange to a circle and drill it for rivets. You must roll the shell and drill that also, as it is too small to punch before rolling. Next, you have all the rivets to put in, and it must be calked. To make such a tank with the welder, all that is necessary is to make the flange out of flat iron, weld it, roll the shell, prepare the scarfs, and weld together.

"The flat iron is more easily bent than the angle. You can save one third of the weight of the shell, for the double-riveted lap joint you have been using is only about sixty-five per-cent efficient, while the welded joint can be taken as ninety percent. What this means in dollars and cents is that you can make a welded shell of one-quarter-inch plate that will be as strong as a riveted shell made of three-eighths-inch plate."

Old Bill produced a sketch, Fig. 4.

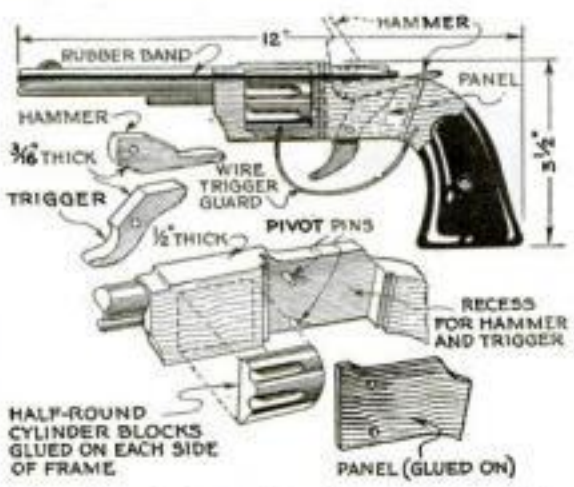
"Here is a job that we can tackle for a starter," he said. "It is a stand for a tank, and we have fifteen of them to make. The steel is being cut to length now."

Old Bill left the group. He was thinking of how many different kinds of work he could do with his new tool, of how he could accept work that he had formerly let go to other cities, and of ingenious ways of cutting costs. Some of these will be described in a future issue.

Realistic Wooden Revolver Shoots Rubber Bands

Costing practically nothing to make, this toy revolver gives a boy much harmless amusement.

RUBBER bands cut from an old inner tube can be shot 30 or 40 ft. with a wooden pistol made as illustrated. The length of the barrel depends upon the size of the tube from which the bands are to be cut. If the bands are from a 3-in. inner tube, the distance from the end of the barrel to the notch on the hammer should be 9 in. In other words, the band should be stretched about three times its original length. The width of the band should be about ¼ in.—ROY C. BRADBURY.



Suggestions for making the revolver, which will work, however, even if crudely whittled.

Kalsomine Stippled Walls

(Continued from page 102)

A simple sponge stipple finish in two-tone effect is obtained by preparing the surface, sizing it, and first applying a plain coat of colored kalsomine. Brush the material out pretty well and immediately lay it off in all directions with the tip, using light semicircular strokes. Allow this first coat to dry half a day or more.

The two-tone decorative finish illustrated in Fig. 2 is extremely simple to do. The first coat should be either a light tint or a medium dark shade; this determines the general color tone of the walls. To illustrate, suppose you wish the general tint of the room to be light and on the yellowish order. Select ivory, cream, buff, or light yellow for the ground coat. For the second coat choose a harmonizing color such as light blue, bluish gray, old rose, or tan.

The second coat is applied with a sponge. Soak the sponge in water and squeeze it out as dry as possible. Spread a brushful of the mixed kalsomine on a board or a sheet of tin and pick it up on the sponge. Then use the sponge as in Fig. 1 to stipple—that is, to pat—the wall with color, moving the hand freely first in one direction and then another and taking care not to work in a straight line or in a mechanical way.

Any number of colors may be used and three are popular; for instance, light blue and old rose over a cream ground (Fig. 3). Dark shades for the ground color and one, two, or three light tints for the stipple coats are effective.

Gold and aluminum bronzes and mixed bronze colors are introduced in some schemes. They may be mixed with glue size (2 or 3 ozs. of glue to 1 pt. water).

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

Here Are Correct Answers to Questions on Page 51

1. There is no need for a funnel on a ship driven by any form of internal combustion motor. However, a ship without funnels would have a strange and unnatural appearance to most people and consequently funnels are fitted and used for ventilating purposes instead of to carry off the products of combustion.

2. It would be possible to design a ship with the propellers at the front instead of in the usual stern position, but there would be no advantages and several disadvantages. Water, unlike air, is an incompressible medium and the slip stream, or column of water moved by the propeller, would impinge directly on the bow of the boat and thus tend to retard its speed. Besides that, if a ship with the propeller mounted forward encountered any submerged log or other obstacle the propeller would be damaged, whereas with stern mounting the propeller is protected.

3. Within the size ranges where Diesel type engines can be satisfactorily constructed, it is more economical to operate a ship with internal combustion engines, but Diesel engines have not been successfully made in sizes large enough to run the great trans-Atlantic liners. Many of these, however, burn oil instead of coal under the boilers to produce steam. An important advantage of oil instead of coal in this connection is that the fuel oil takes up less space in the hold of a ship than an equivalent amount of coal.

4. A sonic depth finder is an apparatus for determining the distance from the bottom of the ship to the ocean floor. It produces a sound which is reflected back from the bottom. The length of time between the departure of the sound and its return in the form of an echo is carefully measured. As the speed of sound is constant, the distance the sound travels in making the round trip can be calculated accurately.

5. It is not common for submarines to make long journeys under water without coming to the surface. The air contained in the submarine is sufficient to sustain life for many hours without the use of any additional supply. In emergencies, a reserve supply of fresh air contained in tanks under high pressure can be let into the ship to replace the exhausted air.

6. A ship does not roll over in the water because its center of gravity for any ordinary amount of roll does not pass beyond the center of support, which is the center of gravity of the water that the ship displaces. A modern liner in dry dock gives one the impression that the center of gravity is much too high for this to be possible. Actually, though, the center of gravity is considerably below the center of shape because the heavy engines, fuel supply, and so on are located in the bottom of the hull.

7. A sextant is an instrument by which a navigator can measure the exact angle of the sun above the horizon. This knowledge, coupled with the exact time, allows the navigator to calculate his exact position.

8. A ship floats because it weighs less than the water it displaces. Ships' hulls are hollow, so, although the steel of which they are made is much heavier than water, the complete ship floats because most of its volume actually is air, which is far lighter than water. If a ship were made of solid steel it would, of course, immediately sink.

Try this Yardstick on YOUR Brain

MEASURE YOUR KNOWLEDGE *with the* POPULAR SCIENCE QUESTIONNAIRE

1. Why does radium continue to give out heat for thousands of years?
2. Are the stars solid like the earth?
3. How was the earth formed?
4. Why is glass transparent?
5. How do we know that the earth is slowly shrinking?
6. What is an electric current?
7. How was petroleum formed?
8. Do electrons really move through wire when an electric current is flowing through it?
9. What physical changes in your body are produced by fear?
10. How do muscles exert power?
11. What are X-rays?
12. Can we see atoms with a microscope?
13. Why does heat expand things and cold contract them?
14. Why does the moon appear to change its shape from time to time?
15. What is the brain made of?
16. Why is it possible that the inside of the earth is growing hotter instead of colder?
17. Why is frost more likely on a clear night than on a cloudy one?
18. Does thinking use up the thinker's energy?
19. Which travels faster, electricity or light?
20. What simple test will distinguish wool from cotton?
21. What makes the noise of thunder?
22. Why would men ultimately suffocate if all the green plants were killed?
23. Does the boiling of water remove the impurities in it?
24. How do the living cells of the body get the energy with which to do their work?
25. How is the speed of light measured?

TOTAL PERCENTAGE.....

EVERYBODY is talking about the famous "Popular Science Questionnaire." Doctors, Lawyers, Professors, College Graduates and thousands of others have tested themselves with this Questionnaire. In the panel is the list of questions of which the Questionnaire is composed. How many of them can *you* answer?

Like an Old-fashioned Examination

May we ask you to make this test carefully, reading the questions slowly and giving thought to each one? When you cannot answer one satisfactorily to yourself, put a zero (0) beside it.

On the other hand, give yourself credit of four (4) for each satisfactory answer. Then when you are through, see how near you have come to making a mark of 100.

This is like an old-fashioned examination, but you will find it fascinating. The questions all have to do with the wonders of the world we live in. All can be given quick and straight forward answers by any person of education.

All of the questions in the famous "Popular Science Questionnaire" and many hundreds of others, have now been answered, for the first time, in one book—THE POCKET GUIDE TO SCIENCE.

All that you probably ever will want to know about science is told in this one 284-page book that will fit in your pocket or grace a library table. Curiosity-satisfying facts about the world we live in are made instantly available to you in simple question-and-answer form in THE POCKET GUIDE TO SCIENCE.

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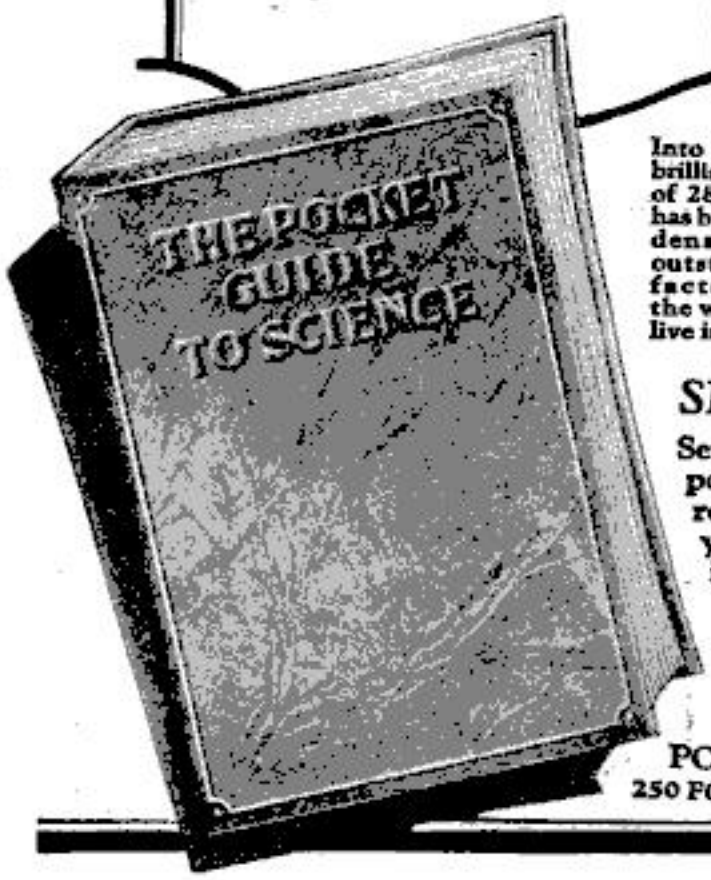

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What Is Ahead in Aviation

(Continued from page 19)

years ago some of the best authorities on aviation stated that in their opinion aviation would not for a long time become so popularized that the private individual would own and fly his own plane. However, the development of plane design during the last two or three years has produced numerous types of small airplanes which are much easier and safer to operate than was considered possible a few years ago. These improvements are being continued.

It is safe to say that in two or three years the average man who is athletic and can drive a motor car will be able to buy, at a reasonable price, an airplane which will be a safe and practical vehicle for his use.

As a natural result, there is considerable talk throughout the country of flying clubs and aviation country clubs, where members who cannot afford planes can learn to fly at small expense and have the use of the club's airplanes. The idea should appeal to aviation enthusiasts during the number of years ahead while airplanes still remain—like the automobile of some years ago—too much of a luxury for the average man of small means to purchase. Through these clubs pilots will be trained as experts for commercial flying activities, and in time of war will help supply the demand for pilots in the Army and Navy.

ENGINEERING

ALEXANDER KLEMIN
Professor of Aeronautics, New York University

ON THE aerodynamic side, the airplane is on the eve of a very great advance from the point of view of decrease of landing speed by the application of the Handley Page Slot, and possibly other lift-increasing devices. Decrease in landing speed will also bring with it a decrease in the length of landing run and take-off run. The safety of flying will thereby be greatly increased, and it will become possible to use smaller fields than heretofore.

The power required to propel an airplane of a given weight at a given speed will be greatly decreased. To achieve this advance designers will use internally braced wings with no struts or wires to impede flight, wings will run smoothly into the body, and engines will disappear inside the wings. Landing gears will be retracted into the fuselage or wings with perfect security. The airplane of the future will be a flying wing of extraordinary efficiency.

The aircraft Diesel engine, burning heavy, noninflammable fuel, will replace the gasoline engine. Fire hazard will thus be eliminated, and costs of operation will be greatly reduced.

Wood will disappear from the structure. The all metal airplane of the future will be much more rugged and have a much longer life than the plane of today.

Attention will be concentrated on the comfort of passengers. Cabins will be thoroughly heated and perfectly ventilated. By the use of mufflers, special propellers, and noise insulating material, cabins will be made almost noiseless.

MORE SPEED

EDWARD A. STINSON
President, Stinson Aircraft Corporation

ACCEPTED basic design is now incorporated in practically every commercial plane, and there are few departures toward the "freak" line. The fast single-motored plane fulfills the demand for air travel adequately at present, though the future will probably see a trend toward the multi-motored type of equipment.

Large multi-motored planes capable of carrying huge pay loads are being constructed to meet the future needs of aviation. They will become more generally (Continued on page 125)

What Is Ahead in Aviation

(Continued from page 124)

used when mass production and motor cost are such as to keep initial cost and cost of operation within bounds that will return a profit both on short and long distance hauls.

Meanwhile much research is being conducted along the line of helicopters and planes that incorporate vertical lift. This type must come about in order to meet the demand of the public for a "flivver" type of plane suitable for landing and take-off in restricted districts.

Aviation is definitely heading for more speed and the elimination of the human factor in the control of the plane itself. Railroads are now equipped with automatic signals and a similar system must be found for the operation of airplanes fitted to carry their pay load at high speed with safety and economy.

MAIL, EXPRESS

C. S. ("CASEY") JONES
President, Curtiss Flying Service

REASONABLY soon we shall see all first-class mail carried at regular rates by airplane, certainly between the larger centers. Slow-moving air liners of large capacity will fly nightly throughout the land carrying fast express, newspapers, and the like.

Passengers who can pay for speed will take long air trips by night or day in as much comfort and safety as aboard trains today. Many of the larger corporations will maintain for their officials who travel veritable flying offices where the executives can work, hold conferences, and keep in touch with their home offices by radio during flight.

Airplanes will be used for advertising, mapping, photography, and for other things of which we have no inkling today. A goodly number of private sport owners will fly for pleasure, business, or both; though a tremendous popular demand in this field awaits a plane that is foolproof and that can be kept in the garage and flown off the roof, lawn, or street.

Trans-Atlantic flying will be accomplished by lighter-than-air machines. Of this much we can be reasonably certain. In the imaginative realm it may sometime be possible to discard motors entirely and derive all the driving energy from electrical forces at present unknown.

AMPHIBIANS

IGOR I. SIKORSKY
Vice President, Sikorsky Aviation Corporation

IT IS probable that during the coming ten years we will see considerable development in the amphibian airplane, which will become the predominant type of privately owned aircraft. The possibility of operating from either land or water permits reaching the center of most cities by landing on a river or harbor. In general, the tendency will be toward all metal, multi-engined aircraft.

Another future development will be the giant flying ship. At present, with the rapid development of passenger traffic, the time is approaching when larger lifting capacity and greater comfort for passengers will be required. Therefore, large airplanes carrying fifty to a hundred and more passengers will certainly appear very soon.

Also the question of regular trans-Atlantic flying will be solved, first for mail-carrying only and immediately thereafter for regular passenger service at an approximate thirty-hour schedule. The most reasonable solution appears to be large multi-motored amphibians operated in conjunction with the Armstrong Seadrome floating service stations.

Still further will probably come the new type of airplane with highly (Continued on page 126)

What Is Ahead in Aviation

(*Continued from page 125*)

supercharged motors and an inclosed cabin with air kept under approximately normal pressure, to permit flying at high altitudes with speeds of say 400 to 500 or more miles an hour. This type, however, will never replace or even approach the number of comfortable, low-flying airplanes traveling not more than 200 miles an hour.

The dirigible will probably have some success, and be the first craft to travel around the world, nonstop.

The helicopter may appear also, mainly in the form of a very small craft to be used for taxi service—possibly from the roof of a house to a flying field, or in between points in a big city to relieve traffic congestion caused by automobiles.

SAFER FLYING

EDWARD P. WARNER
Professor of Aeronautical Engineering
Massachusetts Institute of Technology

THE next few years are likely to be less marked by sensational improvements in the airplane itself than by advances in our knowledge of how to use it successfully. There will be an increase in safety and reliability for commercial air transport and for military operations, which we shall owe partly to improvements in the airplane itself, partly to better training and technique of the pilots, but very largely to improved provisions made on the ground.

To fly through fog or for long distances above the clouds has been a ticklish and a hazardous business. It is reasonable to hope that it will become commonplace and unexciting. Better lighting, better aviation fields, wider provision of radio, better weather service, and better instruments for the airplanes themselves will all contribute to that end.

For the private pilot of comparatively little skill, the future holds prospect of greater assurance against accidents. Much has been done toward building safety into the airplane so that it may be less dependent upon the vigilance of its operator, and more can be.

We may look forward to occasional developments in improvement of speed and of economy, such as that which has resulted from the recent discoveries of the National Advisory Committee for Aeronautics upon the efficient cowling of a radial air-cooled engine.

RADIO AIDS

DR. J. H. DELLINGER
Principal Physicist, U. S. Bureau of Standards

IN THE future the hazards of weather will not be permitted to delay or cancel flights as at present. This necessary change will be brought about by radio.

The service of radio to flying will be in three steps.

The first will be the provision of radio telephone bulletins at regular intervals to all airplanes in flight, giving necessary information about weather and landing conditions. Stations are already being erected by the Department of Commerce to give this service.

Second, airplanes will be guided along their courses by directional radio methods. A system of special radio beacons is being installed for this purpose, an indicator on the airplane instrument board giving the pilot assurance that he is on his route.

The third of these functions of radio is to be special devices at landing fields which will assist the pilot in landing regardless of fog or other weather conditions. These devices will indicate to the pilot his distance above ground at each instant, as well as indicate the confines of the landing area. (*Continued on page 127*)

What Is Ahead in Aviation

(Continued from page 126)

This development is now in the research stage.

The advent of radio in general use on the airways will give the answer to the hazards of the weather. It may be confidently expected that this will introduce a new era of commercial reliability of air travel and transport.

NIGHT FLYING

MAJ. GEN. JOHN F. O'RYAN
U. S. Army Reserve, President, Colonial Airways

IN THIS country we have been successful particularly in having developed night flying to standards worthy of acclaim. Its importance will be understood when it is noted that the commercial value of speed in the air is measured by the distance that can be flown after the close of the business day to other points in distant parts of the country, to arrive there in time for the opening of another business day. We have, for instance, the overnight mail service between New York and Chicago, and other similar services between large cities.

Increasing the number of intermediate landing fields and improving existing ones is removing one remaining hazard of night flying. As to fog, experiments are being made to dissipate fog in the vicinity at least of the ship. Other experiments are being made with fog-piercing lamps and rays of various kinds. Perhaps the best promise along this line is the development in guiding radio beams and radio communication between plane and airport office.

In the building of air transport planes the trend is certainly toward all metal construction. Another tendency is greatly to widen the cabin or fuselage and bring some or all of the motors within the ship itself, making them available to the mechanic during flight. The new Burnelli plane is a splendid example.

Research is looking to the development of new types of motors, some radically different from those now in general use. Some promise lighter weight, less fuel consumption, increased power. There seems to be a real justified expectation that gasoline as a fuel may pass out and a nonexplosive fuel be substituted.

Air transport companies are relying more upon amphibians and seaplanes, which despite their greater cost of maintenance than land planes, can operate with greater facility along the coast and on waterways throughout the country. In some cases they give closer approach to business centers than the nearest landing field.

Another trend is toward the development of aircraft which will take off and land either vertically or at such an angle as will make a long runway unnecessary. Though this, of course, is still in the experimental stage, great progress has been made in landing in the "windmill" type of craft generally known as the "autogiro." However, it requires a considerable runway for taking off.

FOUR BIG GOALS

C. M. KEYS
President, Curtiss Aeroplane and Motor Company

AVIATION in the United States is now definitely commercial rather than military insofar as the public interest is concerned. The great objectives of the engineering division may be briefly outlined, as follows:

1. Reduction of all elements of risk to a point where travel by air is as safe as travel by rail.

2. Reduction of cost of operation to a point where passenger traffic in volume can be carried over long distances at rates very slightly in excess of rail rates.

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What Is Ahead in Aviation

(*Continued from page 127*)

3. The conquest of the hazard from fog, sleet, and snow.
4. Reduction of landing and take-off speed to permit of the use of smaller fields.

In all these aims steady but not very rapid progress is being made. Only now for the first time have operators of airplane companies any reliable data from which to work in respect to costs. The principal elements upon which, in this most important item, work is going forward are: reduction of cost of motors and planes; longer life, especially for motors; use of standard fuels, and consolidation of small operations into large ones.

In the elimination of the risks of flying, weather is, of course, the most important element of danger, and the means that are being used to accomplish the elimination of this risk are better meteorology, better communication and radio beacons, and better lighting. Much is hoped from the experiments with fog that are being carried on, both by Government and private agencies.

LOWER COSTS

HARRIS M. HANSHUE
President, Western Air Express

OVERNIGHT transcontinental express and passenger services at rates considerably lower than the present charges by surface carriers is a definite prospect for airplane transportation within the next decade.

During the current year transcontinental services should be brought within a twenty-four-hour limit, using immediately available equipment, which aeronautical engineers admit to be far short of the ultimate developments in their field.

Increased speed and improved methods of operation will bring rapidly descending costs for express and passenger transportation until eventually airplane transportation will become not only the most dependable and comfortable mode of travel, but also the cheapest.

The future of aviation rests with the commercial aircraft manufacturers in the degree to which they meet the demands of improved airplane manufacture.

The cheap, fast transportation ultimately available by air carriers should change our whole trend of travel, permitting salaried men and women living on either coast to spend a few days' vacation on either seaboard.

Practically all of the large airplane manufacturers are keeping their plants operating under full pressure in keeping up with orders for planes. New airways are being opened the world over and factories are being kept busy producing equipment for contemplated passenger services.

ONLY BEGINNING

F. B. RENTSCHLER
President, Pratt and Whitney Aircraft Co. and President, Aeronautical Chamber of Commerce

WITHIN the last year commercial aviation has made real progress toward proving itself of real utility in the transportation field. Air mail operations are approaching a generally profitable basis of operation, and the public are appreciative of the service which is being rendered. Air mail mileage is being rapidly expanded. It may be said that this service is still the backbone of commercial aviation.

With the advent of larger power plants and ships, the transportation of passengers over regular routes is fast becoming a fact, and it is believed that the period just ahead will demonstrate that this is a sound business. A number of well-organized, experienced, and financially responsible groups are now engaged in exploiting this field. (*Continued on page 129*)

What Is Ahead in Aviation

(Continued from page 128)

It is not felt, by any means, that we have reached a period of standardization in aircraft equipment. There is still as much, if not more, development work to be done than in any previous period. Aviation still needs the engineer more than it does the manufacturer.

MORE AIRPORTS

S. M. FAIRCHILD
President, Fairchild Aviation Corporation

S. M. Fairchild

AIR transportation is the fast medium of travel and holds enormous possibilities for the future. It is not used at present on the large scale that it otherwise would be, due to the lack of terminal facilities such as landing fields and airports, and the high cost of equipment. The latter, in turn, is due to the limited quantity in which equipment is manufactured and enormous mechanical difficulties, which will be rapidly overcome.

The future will find air fields so thickly spotted over the United States that the individual owner will be continually within landing distance of a field in case of any mechanical trouble. This will eliminate the necessity of multi-motor planes for the average owner. Multi-motor planes will have a wide field for country over which there are no air field facilities and for fast transportation.

The airplane can be built many times its present size without decreasing efficiency. The most efficient machines will land very fast, and therefore there should be a field for machines such as the Cierva-Pitcairn autogiro for use in taking passengers to the terminals.

New alloys and metals will reduce the structural weight of the plane and increase the payload. Planes will not be all metal or all wood, but of artificial composition.

BETTER THAN BIRDS

GIUSEPPE M. BELLANCA
President, Bellanca Aircraft Corporation of America

THE invention of the wheel represented the biggest progress from the walking of man. The airfoiled wing is in the air what the wheel is on the ground.

Today we fly better than birds in certain respects—in climbing and speed. Excellent airplanes are flying with a margin of safety that justifies popular confidence and enthusiasm.

Aviation is headed toward standardization of airplane types and of parts, lowering cost of production and making possible the popular use of airplanes. A common tendency of the past year has been increasing use of metal—a promising field for future research due to scarcity of airplane lumber and the steady improvement of metals. Present engineering and aerodynamic information is sufficient for us not only to design any standard type of plane and its parts, but also to construct giant ships of the air for hundreds of passengers. What we need most is more confidence in this ability.

The new large and powerful airplane of the future will have more than one plane and many engines totaling thousands of horsepower. While there will be a prevailing future demand for monoplane types in small and medium-sized ships, after reaching a certain size we will turn to the multiplane as the best compromise between aerodynamic design and structural practicability.

New Calendar by 1933—Eastman

(Continued from page 32)

biggest thing I got out of Africa," he said, as we mounted the stairs to his private study. "Just about a year ago I shot him."

But it was not clear—until Mr. Eastman made it clear—how his latest and perhaps his foremost enthusiasm, the reform of the calendar, fitted in with all the rest.

"I am interested in calendar reform because it will help everybody who works, from the head of a great business down to the corner grocer, to get more out of life," he said, in answer to my question.

"How will changing the calendar accomplish that?" I asked.

"By making it easier for people to enjoy their leisure, giving them, in many cases, more leisure to enjoy," he replied.

That was not easy to follow. Mr. Eastman elaborated his argument.

"A SCIENTIFICALLY-DEVISED calendar, generally adopted, will simplify and standardize business practices and so make it possible for invested capital, and for the man who works, to earn more money, or to earn the same amount with less effort," he said. "More money with less work means more leisure and greater means to enjoy it, and that is the most important thing in life. I am interested, primarily, in efforts to show people how to get the most out of life.

"Now, the more highly standardized our business practices become, the more we can accomplish in given time, the more certainty we can introduce into business and the more we can put into everybody's pockets. That means everybody can have more time and opportunity for play.

"I see in the International Fixed Calendar, the thirteen-month year devised by Mr. Moses B. Cotsworth, a long step toward the better standardization of business, and so an advance toward the ideal condition in which everybody will have ample leisure and means to enjoy it.

"When the League of Nations appointed a commission on calendar reform, no less than 185 different schemes were proposed. At that time the thirteen-month plan was not regarded very favorably in Europe. I think I am safe in saying, however, that it is steadily gaining ground. It is the most radical of all the proposed changes, but in operation would be by far the most efficient.

"THERE is nothing sacred about the calendar," went on Mr. Eastman. "It has been changed so often in historical times that there is no ground for reasonable objection to changing it again. Julius Caesar established our own calendar, Augustus Caesar changed it, other Roman emperors tinkered with it, the Council of Nicaea changed it again, Pope Gregory VI changed it again."

"The Cotsworth calendar is in step with the spirit of the times and is no more radical than a thousand other innovations to which we have become accustomed."

The Cotsworth calendar is simplicity itself. Every month would begin on Sunday and end on the fourth Saturday thereafter. Monday would always be either the second, the ninth, the sixteenth or the twenty-third of the month, and so on. Curiously, each month would have a Friday the 13th.

"There are some persons who are apprehensive because Friday would fall on the thirteenth thirteen times every year," said Mr. Eastman, smiling. "I should hate to believe that this modern scientific world has not progressed beyond silly superstition."

The new thirteenth month added to the year would be placed between June and July. The name "Sol" has been proposed by Mr. Cotsworth and generally accepted by its adherents.

If there were only (Continued on page 131)

A definite program for getting ahead financially will be found on page four of this issue.

New Calendar by 1933—Eastman

(Continued from page 130)

364 days in a solar year, we could simply divide them evenly into fifty-two weeks and assemble the weeks into four-week months. But it happens to take the earth just a shade less than 365¼ days to rotate around the sun—365.2422 days, to be exact. When Julius Caesar established our present calendar, in 46 B. C., he compensated for the extra quarter of a day by making every fourth year a whole day longer, leap year. But in the course of four hundred years this amounted to three days too much compensation, so in A. D. 1582 Pope Gregory VI, on the advice of his astronomers, introduced additional compensation by decreeing that centennial years not divisible by 400 should not be leap years. He corrected the error and other errors made in establishing the Julian calendar by dropping out ten days. The year 1600 was a leap year, because it is divisible by 400; 1700, 1800, and 1900 were not leap years; 2000 will be. This adjustment keeps the computation of elapsed time pretty closely to the actual astronomical facts, and has accustomed the world, for nearly 2,000 years, to an extra day, February 29, every four years.

THE Cotsworth plan would have the excess day beyond the fifty-two weeks of the year inserted as an extra day after the last day in every year. In leap years the additional excess day would be inserted after the last day in June. Both would be extra, eighth-day Sabbath rest days. The former, called year-day, would bear the date December 29, between Saturday, December 28, and Sunday, January 1. The latter, leap-day, would come on June 29, between Saturday, June 28, Sunday, Sol 1, thus making another extra long week-end for summer.

"One of the valuable phases of the thirteen-month year as planned is this recurrence of long week-ends," said Mr. Eastman. "It will be up to each nation to decide what to do about the celebration of national holidays, but those who are backing the plan hope that all anniversaries which are celebrated by public holidays will be observed on Monday, regardless of the actual day of the week on which they fall. We do that now when the Fourth of July, for example, falls on Sunday; it would be just as reasonable to do it when the Fourth of July falls on Wednesday, as it will under the new calendar. When you call that holiday by its correct name, 'Independence Day,' it does not sound absurd to celebrate it on the second instead of the fourth of the month.

"WE HAVE a good precedent for doing just that, in the case of Washington's Birthday, which is observed all over the United States as a holiday on February 22. George Washington was born, as a matter of fact, on February 11, 1732. When he was twenty years old, in 1752, England and the English colonies adopted the Gregorian calendar, which every other civilized nation except Russia and Greece had long since adopted. By that time there was eleven days' difference between the 'Old Style' or Julian calendar and the new one, so eleven days were dropped out of September, 1752, making it the shortest month in history.

"All anniversaries continued to be celebrated on their nominal calendar dates as before, but when the people of the United States began to observe Washington's birthday as a holiday, many years after his death, some pedantic precisians insisted that the dropping of those eleven days in 1752 must be taken into account and that the anniversary of Washington's birth must therefore be observed on the 22nd instead of the 11th. Washington himself never thought of that, but continued to regard February 11th as his birthday, as long as he lived.

"So it really *(Continued on page 132)*

New Calendar by 1933—Eastman

(Continued from page 131)

makes no difference whether an anniversary is observed on one day or another; it is the spirit of the observance that counts. And by observing as a holiday the Monday nearest to each national anniversary, we provide a week-end of two and a half days, or for those who do not work on Saturdays at all, as is becoming the custom in many trades and industries, a recurring three-day holiday."

This idea of celebrating all holidays on Monday, Mr. Eastman pointed out, is not essential to calendar reform, but is the logical outcome. Under this plan our principal American holidays would be observed on these dates:

Anniversary	Present Date	New Date (All Monday)
Lincoln's Birthday	Feb. 12	Feb. 9
Washington's Birthday	Feb. 22	Feb. 23
Memorial Day	May 30	June 2
Jefferson Davis' Birthday	June 3	June 2
Independence Day	July 4	July 2
Labor Day	First Monday in September	September 2
Columbus Day	Oct. 12	October 9
Armistice Day	Nov. 11	Nov. 9

THANKSGIVING DAY, traditionally on the last Thursday in November, depends entirely upon the President's annual proclamation. With all other general holidays being observed on Monday, it is probable that a progressive President might set Monday as Thanksgiving Day, in which case it would fall on November 23 every year, the last Monday in the month.

New Year's Day, under the new calendar, would always fall on Sunday. But it would always be preceded by the extra 'year-day' which would be neither Saturday nor Sunday but simply December 29th. Many would observe 'Year Day' as an extra Sabbath, so it might be that Monday, January 2, would be observed as a holiday.

Christmas and Easter, being strictly religious festivals, would be determined on dates to be set by the churches. There is nothing in the plan requiring a change in the date of Christmas, but since December 23 under the new calendar would be the exact chronological equivalent of December 25 under the present calendar, Monday, December 23, may be adopted as Christmas Day. In the past various other dates have been observed as Christmas.

An essential part of the plan, however, is to fix a date for Easter, because while this is a religious festival, its date also has a decided effect upon business. Easter is now determined by the phases of the moon, being the Sunday after the first full moon following the vernal equinox, which occurs usually on March 21. Easter may thus fall on any day between March 22 and April 25, a period of thirty-five days. In northern countries the earlier date is still winter, while the latter date is advanced spring. The Christian world is accustomed to turn out in new clothes at Easter, but the character of the goods purchased varies with the date of the feast, thus introducing an unsettled element, or one which varies from year to year, into the whole textile and garment trade.

SUNDAY, April 15, has been proposed as the fixed date for Easter, as carrying out the springtime symbolism of the new birth of the world, and as being most satisfactory from a business standpoint. The consent of the great Christian religious bodies must be obtained, of course, before such a fixed date can be decided upon; indeed, the whole problem of calendar reform depends largely upon the attitude of the churches.

(Continued on page 133)

New Calendar by 1933—Eastman

(*Continued from page 132*)

All of them have been consulted. The Roman Catholic Church's attitude probably will be determined by the action of the Ecumenical Council which is to meet in Rome in 1930, the first since 1870. The Church of England, the Greek Catholic Church, the various federations of Protestant churches in Europe and America, all have signified their willingness to adopt any change on which all Christendom can agree.

The only serious objection on religious grounds has come from certain groups of Orthodox Jews, who maintain that the insertion of an extra day in the year would conflict with the Mosaic law requiring every seventh day to be observed as the Sabbath.

AT MR. EASTMAN'S office I was shown the letters he has received from business concerns to whom he wrote asking their opinion about the new calendar proposal. Out of 600 replies, 558, or ninety-three percent, were favorable to the new plan. A surprisingly large number of business houses stated that they long had been using a thirteen-months year in their own business accounting.

"What are the business advantages of the thirteen-month year?" I asked Mr. Eastman.

"The most obvious is the facility of statistical comparisons when all the months are of the same length and each contains an even number of weeks," he replied. "That makes it possible to determine more exactly, from year to year and from month to month, whether a business is going ahead, standing still, or going backward. You can't compare March with February, for example. March has thirty-one days, February only twenty-eight. March is nearly eleven percent longer than February. Sometimes it has five Sundays, sometimes only four. Under the new plan every month would have the same number of Sundays and other days as every other month.

"Another great advantage is the release of capital for business purposes. As there would be thirteen monthly settlements every year instead of twelve, the turnover of capital would be speeded up; in general $28 would do work which now takes $31. The capital so released might aggregate a billion dollars in America alone. Weekly pay days would always coincide with monthly rent-days and other settlement days. That would be to the advantage of the wage-earners, and also to the advantage of employers.

"MEN on monthly salaries would be paid thirteen times a year instead of only 12. The saving of clerical work, in systems of accounting, in all statistical calculations on which science, as well as business, so largely depends, would be very great.

"The principal objections to the thirteen-month year are that it is not divisible into quarters containing an even number of months, and that it would make a radical change in long-established customs. But change in long-established customs is the spirit of the present time, the measure of human progress. In all progressive nations the bulk of business is transacted on a monthly basis. It seems to me there should be no greater difficulty in working with a year whose quarter-days fall every thirteen weeks, on April 7, July 14, October 21 and December 28 than there is with the custom which still prevails largely in England of making Lady-Day, March 25, the beginning of a rent quarter, and Michaelmas, September 29th, another.

"Those differences will all be ironed out, and it is the hope of those behind the movement for calendar reform that some international agreement can be arrived at in time to put the new calendar into effect in 1933, the next year in which January 1 will fall on Sunday."

I Am Learning to Be a Flyer

(Continued from page 28)

a horse on my grandfather's farm. Flying is similar; not very similar, but similar. In horseback riding, balance is important, and in flying balance is important. In horseback riding, one is often tempted to let a headstrong horse do what it pleases. In flying a plane, one is often tempted to let the plane fly itself.

Flying is also similar to driving a car, but, again, not very similar. In one way, a man who drives a car is handicapped when he learns to fly. He is accustomed to looking straight ahead. He seldom looks sidewise or backward; he never looks up or down. In a plane, down, up, backward, and either side is about as important as straight ahead. In flying, the temptation is to keep your eyes glued on the nose.

THERE was little time for asking questions or having them answered after my first lesson with Enslow. Another student was waiting. When we rolled up to the line, Enslow turned about and looked at me. He asked me how old I was.

"Twenty-two."

"Why are you taking up flying?"

"I expect to make a living at it."

He said: "Come every day. If you go stale, I'll know it and I'll keep you out of the air for a few days. Fly at the same time every day. When you get home, sit down in a chair and say to yourself: 'In sharp turns, kick that bottom rudder to bring the nose down.' And when you're ready for bed tonight, sit on the edge of the bed and say to yourself: 'Kick that bottom rudder to bring the nose down.'"

I did as I was told. Next morning at nine, I took my second lesson with Randy Enslow. I was prepared for more rawhide. But Randy Enslow is a man of moods.

We taxied down the field. Enslow made the take-off. After the customary turn above the hangars, he said through the tube: "Grab her! Climb."

I did so. When my altimeter read 1,000 feet, I pushed the stick forward until we were flying level. We flew on and on. Enslow's hands were resting on the cowling. His head moved constantly. There were planes in the air all around us—he was watching them all, as well as a blue plane that one of his students was flying at a much lower altitude. On we flew.

Mud flats appeared beneath us. It was low tide in some river. It presently dawned on me that Enslow was letting me fly where I wished. I did not wish to fly beyond the river, so I made a slow turn and headed back for the field. I decided to make some turns, first some easy ones, then some sharp ones. I made them. It was the first time I had ever done anything without being ordered to.

NOT one word did Enslow say. Sometimes a draft on either cheek warned me that we were side-slipping, and I would work the controls to stop the draft. At other times, especially in sharp turns, the nose would climb, and I would bring it down to where it belonged. No criticism or advice came from Enslow. He was letting me work things out for myself.

I had enjoyed flying the previous day. But today I got my first real "kick," out of it. The ground was no longer a bewildering confusion. I began recognizing landmarks—villages, church steeples, estates, water towers, roads, high tension lines, railroad tracks. More and more I was getting the feel of the ship. It was no longer necessary to watch the horizon so closely. And I was beginning to carry the wings level with the horizon without constant attention.

(Continued on page 135)

I Am Learning to Be a Flyer

(Continued from page 134)

For about forty minutes I flew, relaxed, comfortable, having more of a thrill than I had ever had in my life. I am prepared right now to say that flying is more fun than any other sport or occupation in the world. When you first go up, you carry with you a load of fear, probably planted in your mind by all the newspaper headlines you have read about airplane accidents. It takes a few lessons to shed that load of fear. Then you enjoy the sensation of flying so much, and you become so absorbed in the job of learning to do things right, that you forget to be afraid.

When we came down from that lesson, we sat in the plane for a half hour or longer, with Enslow going over my airwork point by point, criticising, suggesting. He said I had done pretty well. As his next appointment was an hour away, we went into the pilot's room, which was warm, and smoked and talked. I was curious to know about his barnstorming days with Lindbergh. Enslow said:

"We worked Missouri, taking up passengers for $5 a ride. We landed in a town once with seventy-five cents between us. Before night we each had $175 in our pockets. There was good money in barnstorming in those days. Now there's too much competition, but a live wire can still pick up $5,000 a year."

I ASKED him how long a ride had been given for $5.

"Five minutes. But sometimes business was so brisk that we cut it down to two or three minutes. They never knew. In some towns, the farmers would just stand around and stare at us and the plane—afraid to go up. When that happened we went away and came back later. They knew then that to keep us they had to pay for rides!"

I asked Enslow about students. What type did he consider the worst? Without hesitation he answered: "The one who, when he has once soloed, thinks he knows everything. I won't solo you until I am absolutely certain that you should go up alone. You learn to fly as your instructor flies, anyway. The longer you fly with him, the more you'll learn."

"How would you define the ideal student?"

"The man who takes an intelligent interest in doing things properly. One of my students says: 'I get a big kick when I roll her out of a bank smoothly and without side-slipping.' That type of student has his heart in it. He makes instruction a pleasure."

"What was the longest time it ever took you to solo a student?"

"Fifty hours."

"What was the matter with him?"

"On the ground, he was one of the most intelligent men I ever knew—and in the air, about the dumbest. No flying sense."

"HOW do you decide if a student is hopeless?"

"I will tell a student he is foolish to go on with his course if he cannot learn to make a three-point landing. I am doubtful of a student if he does nothing when he makes a bad landing, but lets the plane land itself. Even if he does something wrong, there's hope for him."

"Can you tell much about a student's temperament by the way he handles the controls?"

"By the second or third lesson," Enslow answered, "I usually know all about him. The timid ones are easiest to spot. They always under-control. They are afraid of being bawled out for doing something wrong."

"Do women make good students?"

"No. Women faint. Some are reckless—don't care a continental. That kind can learn to fly."

"Who was your (Continued on page 136)

I Am Learning to Be a Flyer

(Continued from page 135)

most difficult student?" I then asked Enslow.

"A boy of nineteen—the age when flying ordinarily comes easiest. He always carried the nose up when he made turns. And he was always getting rattled and forgetting left from right. One morning I told him, time after time, to make left turns. He made rights. I saw a pile of bricks in a field below us. I landed and put a brick in his left hand and made him hold it for half an hour. It worked fine. After that, he knew which was his left hand!"

"How long did it take him to solo?"

Enslow didn't remember. "A long time. He was a rattlebrain. One day I decided to solo him. His air work seemed all right and his take-offs and landings were pretty good. I had him land us in a field. I climbed out and said, 'All right—take her up alone.' Then I watched his face. It turned as red as fire. I knew he wasn't ripe for soloing. I climbed back in. He made the worst take-off I have ever seen. His air work was worse than a raw beginner's. He would have killed himself five times if I hadn't been there to pull him out of trouble."

I asked Enslow about the term "going stale."

"MOST air companies," he answered, "limit their pilots to a certain amount of flying time a month—fifty or sixty hours. A flyer varies enough anyway, without having to contend with the strain of flying too much. Some days he flies better than others, just as some days a man can play better golf or tennis. Some days I can't teach anything."

"What was the worst scare you ever had?"

"It happened near Rochester, N. Y., about a month ago," he answered. "I was testing a biplane that was tail-heavy. I was climbing. I didn't have a parachute. At 1,200 feet I had a head-on collision. Neither of us saw the other. He was gliding. His nose cut off his view of me; mine cut off my view of him.

"He smashed down on me; wiped off both my upper wings and carried away my elevator and rudder. There I was—1,200 feet up—no controls."

I almost swallowed my cigarette. "What did you do?"

"There was nothing with which to control what was left of the ship but the motor—and the cockpit door. By speeding up and slowing down the motor and by opening and closing the door, I could control her—after a fashion. I picked a big apple tree—and made a bull's-eye hit!"

"Was the other fellow killed?"

"No. His prop was snapped—nothing else damaged. He made a dead-stick landing in a potato field."

"Were you hurt?"

"Not even scratched."

THIS was the most hair-raising flying experience I had so far heard related. I decided I had selected my instructor wisely. A man who could control a plane with nothing but a motor and a cockpit door was a flyer well worth patterning myself after.

"How about your plane?"

Randy Enslow grinned and raised his eyebrows.

"There's a saying in the Army: Any landing you can walk away from is a good landing."

AFTER reading this chapter of Larry Brent's own story, it's easy to believe him when he says that "flying is more fun than any other sport or occupation in the world." Isn't it? And there's still more fun coming next month. Make sure not to miss his next thrilling installment.

Strangest American Sea Mystery Solved at Last

(Continued from page 17)

patriotism and enthusiasm, but who had never seen the sea or a ship, responded, were put in uniform, and placed on duty.

"All of the enlisted men were assigned to this ship less than a month prior to her departure," Commander Worley wrote in the latter part of 1917. "These young men have just recently been enlisted in the Navy for their first term of service and have no knowledge of working a ship or life on board a ship. The engine room force has suffered severely from this condition."

He also asked that important repairs be made on the collier and complained, on a previous voyage, that she had leaked "fuel oil all over the Atlantic." At one time he declared his ship was in no condition to put to sea.

THE *Cyclops*, then, was heavily overloaded. Her cargo probably was not carefully trimmed and was left high in the middle, a condition to cause a sudden, dangerous shift. She had 4,000 tons of sea water in the double bottom, most likely due to the postponement of repairs in the war-time rush to get her cargo to the munitions plant. One of her engines was dead and, to top it all, most of her crew were inexperienced men!

Even so, the collier might have made port safely in favorable weather. But picture a vessel under those conditions trying to weather a severe storm!

What kind of weather did the *Cyclops* encounter?

I searched the reports of the U. S. Weather Bureau for March 9, 1918, the day on which the *Cyclops* had passed the molasses tanker *Amalco*, and for the following day. And I found that violent storms swept from the interior of the United States on the ninth, to a point several miles off the Virginia Capes on the tenth!

This was eloquently supported by entries made on March 9 and 10 in the log of the *Amalco*, a copy of which I found in the Navy files. These showed that, on the evening of March 9, she passed the *Cyclops* at a distance of five miles. And on March 10 she ran into the heaviest gale her master, Captain C. E. Hilliard, said he had ever experienced. The waves washed over the ship and all but sank her.

"IF I had been carrying manganese ore," Captain Hilliard reported, "I could not have survived the gale."

Because of the war, reports from ships at sea were restricted, but the few which did report indicated violent seas coming from all directions.

But why didn't Commander Worley send out an SOS when he found himself in distress?

The answer is plain. German U-boats were believed to be in the vicinity. Any wireless call would attract enemy as well as assisting vessels.

Waves roll high along the Virginia Capes. In times of storm they tower fifty or sixty feet! One slap of such a giant wave, and the *Cyclops* doubtless keeled over. Once on her side, the shifting cargo and the weighty superstructure would have prevented the vessel from righting herself, and she must have dropped like a huge steel weight to the bottom of the ocean. This explains why no lifeboat or even as much as a spar of the ship was ever found.

Thus, in the light of the official facts, the mystery of the *Cyclops*' disappearance is a mystery no longer. Instead, it was another horrible but natural disaster of the sea. The ill-fated collier fell a victim to one of the terrific storms which lurk around the Virginia Capes. And far from deserving the stigma of a mutineer and traitor, Commander Worley appears to have been a stout-hearted sailor and an heroic patriot!

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Modern Noah's Ark Fights Disease

(Continued from page 24)

fever, he shot many a needleful of the fatal fever germs into furry rabbits. Dozens of them died, of course, but finally Dr. Noguchi worked out a serum which is a positive cure for that once dreaded disease. Now, a rabbit can provide enough serum to immunize three men, and the plague of yellow fever has been driven from the western hemisphere within ten years. In Buenos Aires, between 1916 and 1926, the deaths from yellow fever dropped from 927 to none!

The ordinary domestic sheep and cow provide the richest substance ever discovered for combating pernicious anemia. The Rockefeller scientists have found that calf's liver, scraped and slightly warmed, is an effective cure for this malignant disease. The present search of anemia investigators is to find a less expensive substance which will perform the same results. But until they do, sheep and cows will continue to give their only livers to cure pernicious anemia in human beings.

AND thus it goes with every animal in the zoo. A dozen chimpanzees shiver in their cages, trembling with paralysis, while Institute doctors struggle to solve the fatal mystery of that disease. Coiling cobras and rattlesnakes yield marvelous serums against the bites of their fanged brethren, who killed 5,000 people last year.

Everything I saw convinced me that the animals in the Rockefeller zoo were making valuable contributions to the advance of medical knowledge. But I heard neither the groans nor yelps of tortured beasts. And I saw no hacked and maimed bodies of cast-off animals. I asked my guide if there was any truth in the charges of cruelty made by antivivisectionists.

"Do the Institute doctors ever operate on animals without first administering anesthesia?" was my leading query.

Dr. Flexner smiled. "That is the favorite charge of the antivivisectionists," he began, "but as far as I know, it has never been substantiated. In the first place, we are not degenerates here, and we take no pleasure in torturing animals for the sport of it. Actually, the aim of the laboratory investigator is to secure the greatest amount of scientific information with the least shock and suffering to the animal involved. Whenever possible, local anesthesia is employed. Last week we removed a small cancer from the shoulder of an English bulldog. We used what is known as an electro tissue-cutting or "radio" knife, one of the latest scientific means of removing malignant growths. The field of the operation was first anesthetized, and there was no pain during the operation or following it."

A FEW weeks ago the Institute doctors were obliged to shorten a cat's intestine, in order to discover how much of the intestine is necessary to maintain life. They took the same care of her as they would of a human being. A general anesthesia was administered by the best "ether man" in New York. I won't mention his name, for fear of causing jealousy among his high-priced patients. Two nurses were present, and the cat received the equivalent of a five-hundred-dollar operation. In return, she gave up four inches of her small intestine—and still lives to tell her kittens the story.

"But how about these random and useless experiments that your opponents are always bringing up?" I inquired.

"I'd like to see anyone making a random or useless experiment around here," snapped Dr. Flexner. "In the first place, we haven't got the time to waste on unessentials. Secondly, there are strict regulations applying to all institutions in the United States devoted to medical and biological (Continued on page 144)

A definite program for getting ahead financially will be found on page four of this issue.

Modern Noah's Ark Fights Disease

(Continued from page 143)

research. The reports of random experiments are one hundred per cent false, and no antivivisectionist has ever backed them up."

"Doctor," I asked, "what single animal has proved most valuable in scientific experiments?"

The scientist hesitated not a moment.

"THE dog," he replied. "In the first place, a good big dog is the nearest animal in size to a human being. His heart, lungs, arteries, and digestive organs are only a trifle smaller than a grown man's. A dog's blood pressure corresponds closely to ours, he eats just about the same food, and it affects him in practically the same way as it affects us.

"All these considerations bring him forward as a prime subject for experimentation. When we were working on a new theory of blood pressure in 1920, we gathered about four fifths of our material from dogs. We punctured a dog's artery, clapped a sphygmomanometer (a pressure-measuring instrument) over the aperture, and watched the column of mercury rise as it was forced up by the pressure of the dog's blood stream. Allowing for the difference in heart-volume, we were able to figure from this experiment what the normal human blood pressure should be."

I learned that the same kind of thing happens when investigators make experiments with diet. Take that disease of infancy called "rickets," which occurs when certain food elements are missing. The Institute doctors couldn't very well experiment with human babies, so they took the nearest thing on the market—a litter of pups. By feeding half the pups a balanced diet, and putting the other puppies on an experimental diet, they found out what element was needed to prevent rickets. And as a result there needn't be any more bow-legged children. Three little dogs helped wipe out *that* defect in human structure.

Dogs are also the logical animals to use in experiments with asphyxiating gas, drowning, and electric shock. The "prone-pressure" method of reviving gassed and shocked persons was first worked out on dogs. Science had to experiment on an animal with the same lung-wall resiliency as ours. So a dog was gassed, then revived by stretching him out flat and pressing his lung walls to obtain artificial respiration. He came to in grand style.

INCIDENTALLY, while the Rockefeller scientists are making all kinds of discoveries about human diseases and their remedies, they're also helping out the dog—making him happier and healthier. Here's what I mean. There are certain diseases that affect both dogs and men. Tapeworm, rabies, jaundice, and hookworm are examples. Well, after wiping out these scourges for humanity, science has applied the same remedies to the faithful beast that helped find them—the dog. Investigators are now working on influenza, which is very closely related to distemper. And when they solve the mystery of influenza, there will be no more distemper in the dog world."

I asked Dr. Flexner to tell me about the greatest surgical experiment he had ever seen performed upon an animal.

He reflected a moment. Then he replied; "Carrel's famous transplanting operation, in which he exchanged the hearts of two fox terriers, was the greatest.

"As you know, Dr. Alexis Carrel is a Nobel Prize winner for his surgical discoveries which enabled doctors to cut gangrene right out of the picture in the World War. Well, at the time of his famous transplanting experiment, Carrel was interested in removing limbs and organs from one animal and grafting them onto another. He had (Continued on page 146)

A definite program for getting ahead financially will be found on page four of this issue.

Modern Noah's Ark Fights Disease

(Continued from page 144)

already grafted a leg of a dead fox terrier onto a living terrier, and was anxious to prove that the vital organs of human beings could be similarly grafted. But first he determined to 'try it on the dog.' He had to invent his own technique for doing it—and here's how he did it:

"TWO perfectly healthy fox terriers of the same age and size were placed on adjoining operating tables, and fully anesthetized. No torture-table nonsense about Carrel, you understand. Then Dr. Carrel and his assistant made preliminary incisions over the hearts of both dogs. The only thing to do was to stop the heartbeats of both animals until the operation was over. Special clamps, invented by Dr. Carrel, were placed over the valves of the hearts, to prevent the blood from coursing through. Working with the speed and skill of a genius, the heart of each dog was severed at the aorta, or large artery; then each was lifted out by Carrel's own fingers, and transferred to the other dog. Nine minutes elapsed while Carrel sewed the hearts into place—nine minutes of *heart inaction*, during which time the dogs were kept alive by artificial respiration. Then the clamps were removed from the heart-valves, and the blood coursed once more through the new heart! Both animals lived to a ripe old dog age, and apparently never suffered any ill effects."

During my numerous visits to the Rockefeller Institute, I saw several actual experiments in progress, with animals playing a major rôle in each case. Possibly the most interesting and valuable research now being carried on is the experimental work of Dr. James B. Murphy, the leading cancer authority in the United States. Dr. Murphy is experimenting with chickens in an attempt to discover the cause and nature of cancer.

"I use chickens because chicken cancer is very similar to human cancer," Dr. Murphy told me. "Just now I'm trying to *graft cancer from one chicken to another*, in order to prove a theory of mine."

Dr. Murphy led me to a group of his assistants who were injecting a small quantity of local anesthetic under a chicken's wing. After this had been accomplished, Dr. Murphy took a tiny cross section of a cancer which had been removed from another chicken, and with a deft incision placed it deep in the tissue under the chicken's wing.

"If that chicken develops cancer, I'll be the most surprised man in the world," said Dr. Murphy. "I've been building up her immunity for six weeks, and I could swear that the cancer graft won't take on her. But if it does—and stranger things have happened—it'll mean that I must begin all over again on a new hypothesis."

PROFESSOR John Dewey, of Columbia University, once said to me: "Few human activities pay such glorious and profitable dividends as vivisection. Scientific men are under definite obligation to experiment upon animals, so far as such experimentation is a means of saving human life and increasing human vigor and efficiency."

That's just about the attitude of scientific men all over the country. The greatest of our laboratory investigators realize that if laws are passed against animal experimentation, science will be completely paralyzed. In the words of Dr. Alexis Carrel to the New York Assembly:

"If you lawmakers permit an ignorant and fanatical minority to stampede you into anti-vivisection legislation, you will be setting society back 250 years. If laws are passed against vivisection, science may as well shut the doors of its laboratories, and let its instruments rust while disease runs wild."

The Speediest Craft Afloat

(Continued from page 21)

Four years ago someone asked Gar Wood if he thought he could beat the Twentieth Century Limited, pride of the New York Central lines, down the river from Albany to New York—a distance of 143 miles. One fine day Wood left Albany at the same time the train did. Three hours and ten minutes later the train pulled into New York, where Wood had been waiting for twelve minutes. Averaging forty-five miles an hour, he had beaten the crack train.

There is a rumor that Wood plans some day to make a power boat record from America to England. He does not wholly deny it.

"It might be done some time," he says. "All you need is a seaworthy power boat and you can be on your way. Of course, it would be prudent to make sure that no storms would be encountered. The boat would have to carry a lot of gasoline. But it could be done."

WOOD carries his love for the water beyond his boat. He flies to New York on business in his own cabin seaplane, and continues from there down the coast, to his home in Miami Beach, Fla., for the winter season.

"He can fly the ship, land, and take off as well as I can," his pilot, George Cobb, casually told me.

Gar Wood's first job was piloting some "new fangled" gasoline boats that Government surveyors had brought to Duluth harbor, only to find that they couldn't run them.

His mechanical bent led him into the garage business. He took an agency for the Ford car, in the babyhood days of the since-famous Model T. But boats were his recreation, and he saved money to buy one.

"I FINALLY scraped $40 together," he told me. "I found a fellow in Joplin, Mo., who had a motor, so we got together and became the joint owners of a speed boat—a fast one, too, for 1903. I guess it made all of twenty miles an hour!"

Wood was always inventing something. One day, not more than fifteen years ago, he stood watching a truck driver deliver a ton of coal at the garage. Particularly he was impressed by the amount of work it took for the perspiring driver to tilt the heavy dump body by turning a crank. The idea it gave him, had he but known it then, was to supply the money for his expensive speed boats in later years.

He went home and drew a diagram of a proposed hydraulic hoist for dump trucks, and took it to an engineer.

"How much lifting pressure do you expect to get with this?" the engineer asked.

"I have enough to dump a truckload of coal," Wood replied.

"Well, the theory is all right, but the practice isn't," declared the engineer. "You'll never get enough pressure to lift a load of coal."

"I had been taught to believe only half of what I was told," Wood says, "so I went home to talk it over with my wife. She said, 'Go ahead.' I took $200 we had saved and spent it all in building a hoist for a truck. By George, it had a pressure of 350 pounds to the inch—more than enough to lift the loaded body and dump it! The next one I built exerted a pressure of more than 500 pounds."

Wood patented the hoist. Today he has a monopoly on the device. Instead of 500 pounds, the hoist has been engineered so that it develops a pressure of 1,800 pounds to the inch.

Wood moved from St. Paul to Detroit and built a factory in 1914. The factory gave him all the money he could use, and the rest of the story is best expressed in his own words:

"I had worked darn hard for years trying to make money and be useful to the world, so I decided to play with boats."

Do You Know Your Carburetor?

(Continued from page 82)

same speed," Gus told her. "But you know how sometimes the motor just barely turns over while you are waiting in traffic, and the next minute you're scooting down the road with the motor humming like a bumblebee. If you think about that garden spray again you'll see what I mean. If you push the handle back and forth real slow, you don't get any spray at all, and then when you work it faster, all of a sudden it starts to work fine. If the carburetor worked like that the motor would stop every time you took your foot off the throttle. The throttle, of course, is just a valve that regulates the amount of air rushing through the carburetor. Most all of the complications in a carburetor are to make it spray the right amount of gasoline into the air no matter how fast the air goes by. One way they get that result is to make the air passage around the jet real small. Then they fix it so all the air goes through that small passage when the throttle is nearly shut. As the throttle is opened, more and more air is drawn in through another valve that opens in proportion to the amount of suction. In some carburetors they use two jets. One works all the time whether the motor is idling or racing, but the other only works when the throttle is open and lots of air is rushing through the carburetor. That's the way the carburetor on this car is made.

"THAT'S about all there is to the theory of carburetors," Gus went on, "except about the float chamber. You know how nice your garden spray works when you have just the right amount of liquid in it. The carburetor is the same, and to keep just the right amount of gasoline in it all the time, this float chamber here keeps the level of gasoline always the same no matter how fast or slow the gasoline is drawn through the jets. The float inside it works a needle valve, so when the gasoline flows into the chamber and lifts the float it shuts the valve. When gasoline is drawn out of the float chamber the float naturally drops a bit and opens the valve again, and more gasoline runs in."

"Isn't it just too thrilling!" said Marianne. "Now when I get stuck all I've got to do is turn those funny little knobs to get a better adjustment and it'll start again just as easy!"

"That's just exactly what you mustn't do," Gus commanded. "The first thing you do when you get stuck on the road is to see if you've got any gas in the tank. Then you can tickle this float button and if gasoline runs out of the bottom of the carburetor look for the trouble somewhere else. Chances are ten to one it isn't in the carburetor at all. Lots of people think the carburetor is to blame for most stops on the road and right away they start tinkering with it till they get it all out of whack.

"ABOUT all that can happen to a carburetor is to have the jets get clogged or the float spring a leak and sink. Generally you can clear clogged jets by jamming your foot on the throttle and pulling the choke all the way on for a couple of seconds. The extra suction drags the dirt or water right through.

"There's no way to fix a leaky float except to take it out and solder the hole, but usually the motor will keep on running after a fashion so you can get to a service station, anyhow.

"Now run along, young lady. Joe and I have a job that's got to be finished before noon. Right now you know more about carburetors than most men do! Drop in again and we'll take up some other part of the car.

"Well," he remarked to Joe as Marianne's roadster rolled through the doorway, "as I told you before, it's just a matter of knowing more than the dog!"

"Da Vinci Did It First"

(Continued from page 44)

could be read only with the aid of a mirror.

Many pages were found to be filled with notes on soaring birds and sketches of proposed flying machines. Some of these notes indicate that he invented the parachute and also designed a toy utilizing the balloon principle two and a half centuries before the brothers Montgolfier, who are credited with the invention of the balloon in 1783.

The first bat-winged machine he designed was to be made of bamboo, pine, and taffeta, starched to make it air-tight. It was to have flapping wings operated by hand. Later, he designed a craft to be lifted by a propeller run by a spring motor. There is no authentic record that Leonardo ever made a trial of his proposed machines, but, after studying the plans, John William Lieb, an American mechanical engineer, has said: "Leonardo da Vinci stopped just short of practical results owing to the lack of a modern motor."

THE story of how Leonardo became fascinated with the idea of flying throws light upon the extravagant spirit of his time. For a festival, he had designed a huge golden lion actuated by springs to walk up to honored guests and deposit flowers before them. This brought him great popularity at court. One day the idea occurred: "What a sensation I could cause if I flew over crowds at a fête in hot weather, sprinkling snow taken from a mountain top!" The result of this bizarre idea was his discovery of the law of gravitation. For, long before Newton, his aerial investigations led him to the conclusion that "a weight seeks to fall to the center of the earth by the most direct way."

From Florence, Leonardo was invited to the court of Milan to play the harp and sing his own compositions. While there, as a further tribute to his versatility, Caesar Borgia made him military engineer in charge of canals and waterways. In this capacity, he formulated some of the earliest laws relating to hydraulics. He planned a canal from Pisa to Florence, diverting the waters of the Arno. Two hundred years after his death it was constructed exactly as he had projected it.

To speed the work of canal construction, he designed a unique "ox-shovel." At one end of a rope over a pulley on the framework of the machine was attached a huge basket; on the other end a platform. The basket was lowered into the excavation, the platform rising to the level of the canal bank. When the basket was full of earth, an ox was led on the platform. As it sunk under his weight, the basket rose and was swung out and dumped on the canal bank, much as a modern steam shovel operates. The ox walked up an incline to repeat the process.

AS MILITARY engineer, Leonardo's original mind planned a huge armored car similar to the modern tank, and suggested placing vanes at the rear of projectiles as is done with aircraft bombs of the present. His design for a steam cannon, in which the ball was to be ejected by a piston operating in a cylinder, was the direct forerunner of James Watt's steam engine.

Mechanics he called the "paradise of sciences." Tired from his painting, he continually found relaxation in his tools and in devising new machines. One of his most ingenious inventions was a spit for roasting meat before a fire. A fan mechanism that turned the spit was moved by the hot air rushing up the chimney. Thus the spit automatically turned rapidly when the fire was hot and the meat in danger of burning, and more slowly when the heat died down.

No human being could carry out all the designs of Leonardo's untiring brain. He planned much that he never had opportunity to try. But time has revealed that invariably his ideas were steps in the right direction.

One of his drawings shows a proposed automobile which was to be run by a spring motor. Another reveals a diving suit in which air was to be supplied to the occupant by a tube, as in modern suits. He designed a life belt which could be inflated in an instant in case of shipwreck. Wire rope was suggested by him and he thought of using jewels for bearings. His "camera obscura" mechanism forms the basis of all cameras. Machine shops everywhere fight friction by means of roller bearings, first thought of by Leonardo. Such were the products of his hours of "leisure."

Early in the sixteenth century he drew a map of the globe, said to be the first to include America, and also showing an Antarctic Continent. It was this type of map that was used by Magellan and other early navigators. Even before Columbus sailed from Spain, Leonardo not only maintained that the earth was round but calculated its diameter to be more than 7,000 miles. The actual diameter, as now accepted, is roughly 7,900 miles!

Fossils, which he picked up on the mountain sides, were called unusual mineral formations by his friends. He correctly declared them to be skeletons of animals. His theories as to wave motion and ocean currents have been shown to be largely correct.

Leonardo had more exact knowledge about the human body than any other man of his day. In preparation for his paintings, he dissected bodies and plumbed the secrets of the human organs until he was able to write clear dissertations on the theory of nutrition, on nerve cells, on blood vessels, and on hardening of the arteries. Before Harvey, he understood about the circulation of the blood, although he did not know how it was accomplished.

MOST botanists now agree that the age of a tree can be told by counting the rings in a cross section of the trunk. Leonardo's sharp eyes are said to have been the first to discover that fact. Another important discovery he made in the field of botany was the principles of phyllotaxis, or the laws governing the distribution of leaves on an axis.

Before Copernicus, Leonardo wrote: "The sun does not move!" and proclaimed that the earth rotates about it. A century before Galileo, he proposed a telescope, making a note on his manuscript: "Construct glasses to see the moon magnified." Before Bacon, he propounded the important law of inductive reasoning, saying: "Without experience, there can be no certainty." Two centuries before Amontons, he formulated laws relating to friction. It has been truly said: "Leonardo da Vinci discovered twenty laws, a single one of which has sufficed for the glory of his successors."

During his last years, the constant warfare of Renaissance Italy exiled Leonardo to France, where he was received with honor at the court of King Francis I. When he died in 1519, at the age of sixty-seven, a clause was found in his will that reflected that thoughtful kindness which had characterized his life. It provided that sixty poor men should be hired to act as candle bearers at his funeral.

Up to his last days he was busy painting and studying. This was as he had wished. "As a well-spent day brings happy sleep," he had often said, "so life well used brings happy death."

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Do Insects Think Like Men?

(Continued from page 25)

usually are in the form of oval or tunnel-shaped chambers made of bits of grass interwoven with silk. Major Hingston watched ants driving one of the "cows" up a stem toward its shed. They coaxed it on, urging it from behind with their antennae, just like human cattle drovers! If it tried to turn back, they pushed it; if it went off along a side stem, one of the pair ran out beyond it and drove it back to the right road.

One day, he found on the branch of a tree a "stable" in which the wind had torn a large hole. The "cattle" were escaping down the tree. Four ants went quickly after the runaways, got below them, and cut them off! They probed them with their antennae, bit at them with their jaws, and drove them back to the damaged shed. They got them in, guarded the opening for a while, and later in the day repaired the hole!

Judgment and resourcefulness of a different order were shown in the doings of a tribe of powerful excavating ants. Major Hingston watched at their clever construction work 4,000 feet up in the Himalayan Mountains.

THE ants had made a nest on the side of a bank. The ejected earth ran down from it in a steep chute, like a landslip on the face of a hill. As each ant carried out its load, it slipped on the loose material and tumbled to the bottom of the slope. But the builders refused to be defeated. After some days of slipping and falling they devised an ingenious plan. They constructed a parapet!

This is how it was done: One particular ant collected pebbles near the foot of the slope, dragged them up, and spread them out in the form of a platform at the top, just outside the mouth of the nest. On this parapet the excavators could walk with safety, and after that not one of them fell down the slope!

Similar ingenuity is demonstrated in the nest-building activities of the red tropical tree-ant, which builds its house by drawing leaves together and fastening their edges with silk. The ants stretch across from leaf to leaf, gripping the edge of one leaf with their jaws, the edge of the other with their hind legs. Then they pull, and the leaves come together. If the leaves are so far apart that single ants cannot span the gap, the workers link themselves together in pairs. One grips the other by the waist, and in this way they almost double their length. If the gap is still wider, three or even four join the chain.

THE pulling is done with fine teamwork. The ants range themselves side by side like little soldiers. The jaws of all grip one edge; the hind legs of all grip the opposite edge.

Together they haul, like sailors hoisting the mainsail on a ship.

Then comes the stitching! Ants cannot make silk themselves, but their larvae possess it for cocoon-making purposes. Now, as soon as the leaves have been drawn together, an ant appears with a larva in its jaws. It lifts the larva from side to side and gently applies its head to the edges of the adjacent leaves. Wherever the larva touches a leaf it attaches a thread of silk. One of the most wonderful features of this performance is that the tiny larva actually coöperates with the ant! It never neglects to affix a thread, and bends its head to the leaf each time it is lowered by the ant. This process continues for days! When one larva is exhausted, another is brought. Millions of threads are woven back and forth in this manner, and in the end the leaves are firmly "sewn" with a strong white layer of silk.

Speaking of teamwork, one of the most amazing manifestations of manlike intelligence in ants is the relay system several species employ in battle and on the hunt. The foraging ants of South America enter a house, ascend in regular files to the rafters, and there chase and capture cockroaches. Then they pitch their victims to the floor, where another regular file of "porters" has been waiting. These carry the cockroaches to the nest as fast as the "hunters" pitch them down!

The lobopelta, a Central Indian ant, adopts a similar method in its wars with the termites (white ant). In plundering a termite's nest, they arrange themselves in a double stream. One stream advances to battle and kills the termites. The other stream picks up the dead victims and carries them off to the nest!

NEXT in intelligence to the ant comes the hunting wasp, which shows remarkable ingenuity in tracking and catching its prey. One species, the ammophila urnaria, which stores caterpillars in its nest, makes use of a stone as a hammer! Two American entomologists watched this wasp closing her nest. First she filled the burrow level with the ground, and brought some grains of dirt to the spot. Then came the amazing act. The wasp picked up a small pebble in her mandibles and used it as a hammer to pound the grains of dirt, thus making the spot as firm and even as the surrounding surface!

Even caterpillars have intelligence. The common white cabbage caterpillar can crawl with ease on any rough object. But when placed on a slippery surface, such as a piece of glass, it immediately manufactures a ladder of silken threads from the glands in its mouth!

Several tests indicate that the lowly cockroach is actuated by at least a gleam of reason. An English investigator recently divided a cage into two chambers, one dark and one light. In the light chamber, he placed a number of cockroaches which, prompted by their natural preference for dark corners, immediately hustled off to the unlighted compartment. But here they received a tiny electric shock. The insects soon learned to remain in the light. A Russian naturalist taught cockroaches to walk a very narrow bridge over a basin of water.

A WONDERFUL example of purely instinctive knowledge of insects is the way spiders keep from committing suicide in their own webs. To avoid being caught in the sticky snare it prepares for other insects, it carefully oils its body with a substance it squeezes from its salivary glands. This is applied only on those parts that are likely to touch the web—the legs, the spinning apparatus at the end of the abdomen, and the mouth.

The marvelous instinctive knowledge of anatomy displayed by the wasp in paralyzing its prey is almost sufficient to make a surgeon turn green with envy! It stings its victim in the nervous ganglia and injects a fluid which acts like an anesthetic. Thus it paralyzes the nerve tissue while keeping the prey alive for its larvae!

Do insects possess intelligence? Major Hingston's conclusion is that the insect mind operates in much the same way as that of man. The chief difference is this: Every animal, man included, possesses two sets of mental activity—one instinctive, automatic, innate; the other intelligent, plastic, and acquired. Instinct predominates in the insect mind; intelligence in the mind of man.

ARE you planning to build a home of your own? If so, you won't want to miss our helpful series of articles giving expert advice on how to choose the right materials and equipment. Next month's article will give valuable information about selecting roof materials.

"I Was Almost Cannibal Stew!"

(Continued from page 43)

Suddenly, like a flash of lightning, a beam of brilliant light shot from the projector and splashed against the screen. Many of the cannibals cried aloud at this, and some darted away. But the majority, fascinated by the miracle, shiveringly stood their ground and waited.

The next event was absolutely beyond their comprehension. *Nagapate himself appeared upon the screen!* His life-size figure walked up in front of his people, bowed, and grinned. But there was the real Nagapate sitting on the ground in front of the screen!

A howl of amazement burst from the savages. Some fled in terror. Others swayed to and fro with astonishment and fear.

It was the greatest thrill in my life! I had shown the tribe that without even hurting them I could disembody their spirits and make them walk in thin air! From that moment on Nagapate paid me all the homage due a chief more powerful than he.

EARLY in 1923 I led an expedition to the wild northern frontier of British East Africa and established a base camp in the crater of an extinct volcano just over the border from the southern edge of unexplored Abyssinia.

Four years I worked out from this base, photographing wild life in its native haunts, studying African game: lions, leopards, elephants, baboons, rhinos, giraffe, buffalo, oryx, kudus, ostriches, wildebeeste, kongoni, gazelles, cheetah, and okapi.

My sole white companion in most of these adventures was Mrs. Johnson. Experts say Osa is one of the finest rifle shots in the world, and I can quite agree with them. Usually I worked unarmed, cranking away at the camera, while Mrs. Johnson gaged how close she dare let death approach. Many a time I have thanked God that Osa held the gun.

One morning on safari (meaning expedition in Swahili) I began to pick up bits of low conversation from the natives with us. They were speaking of the dreaded *Simba*—the native word for lion. Just then, as if fate chose to endorse their apprehensions, there appeared right ahead of us on the rough floor of the desert the brownish shape of a huge crouching lion.

The lion's tail was switching about like a flag in the hands of a railway guard—his warning signal. He was furiously angry at our intrusion.

I KNEW enough about lions not to go on. Quickly I had my native porters set up the big camera. Osa, who weighs only 110 pounds, stood between us and the lion. Any minute he might charge. Only a shot in the center of his brain or squarely in his heart would stop him.

Scarcely had I started to crank than the beast began to advance. His tail was now flipping violently from side to side; and now and then he gave vent to a harsh roar of fury.

He didn't charge at once. He seemed to be working himself up into an uncontrollable rage. Finally he could no longer resist his desire to annihilate us.

A lion charges at a speed unequaled by another wild animal. It has been estimated that he covers the last hundred yards of his charge in about *three seconds!*

I can't say I enjoyed standing there turning my crank during that rush. It was the most beautiful, yet terrifying sight I think I have ever seen. The lion looked as big as a full-grown bull as he came tearing down upon us, his mane flying and his dripping teeth bared for the final death-dealing assault.

Osa did not flinch. (Continued on page 152)

"I Was Almost Cannibal Stew!"

(*Continued from page 151*)

The black boys were ready to collapse when Osa fired. The huge body checked for a split-second in mid-air, then fell and rolled to a point just thirteen feet, by actual measurement, from my camera's tripod!

On another morning I came out of my tent and saw three rhinos coming towards camp. They were fighting among themselves and running at the same time. Some family row, I suppose; and it kept them from noticing us. Presently the whole crowd disappeared in some bushes behind our tent.

I had a white assistant then, named Saunderson, who now joined Osa and me in trying to maneuver into a position for photographing the rhino group. We were all fully aware of the danger. But since every day was more or less dangerous, none of us anticipated a tragedy.

SAUNDERSON approached too close to the bushes. All of a sudden I heard a blood-curdling scream. Then two shots, then more screams; then another shot and more screams. Osa and I dashed over as fast as we could go and entered the bushes. As we did so there was the crashing of branches and the thud of mighty hooves.

We found Saunderson stretched out on the ground with his clothing torn and a mass of blood. At first I thought he was dead. But we raised him up and found that the rhino had got him in the legs. He was badly cut up on his upper right thigh where a horn had torn to the bone.

We quickly carried him to camp where the cook luckily had plenty of hot water. I washed all the gashes and put permanganate on them. When the injured man could talk he told us feebly what had happened. He had nearly stepped on one of the rhinos. It came for him instantly. He got in two quick shots but they grazed off the beast's horn and thick skull. The rhino kept coming and knocked the man's gun out of his hands and gored him.

After unspeakable sufferings poor Saunderson died.

Often I have been asked how I am able to get the animals to "act" so well before the camera. It's mostly a matter of patience. You often wait for months to get a few hundred feet of exactly the action you want. Even then the film may not be a success. I have taken as much as ten thousand feet of a single elephant herd in an effort to record the characteristic behavior of these strange beasts.

SPEAKING of elephants, one of the closest shaves I ever had was on the edge of the Kaisoot desert where the scrub mimosa comes down and dots the arid slopes. Boculy, my elephant tracker, came running into camp one morning, all excited. He was shouting in short jerks: "Big elephants, Bwana! All together!"

I called Osa to get her rifle. In five minutes our gunbearers were under way. The camera boys were swinging up their heavy loads.

We found the herd feeding in a little donga. They were restive, probably having caught our scent. But there was no good place by them for me to set up my tripod. Like a movie director, I wanted my actors properly placed before the camera.

Leaving Osa at the camera to crank in case any good action developed, I took a rifle and moved up to shoo the herd into the field of the lens—cautiously, for I knew the elephant's quick temper and swift, angry charge.

One of the bulls was a fine tusker, just what I wanted to complete a continuity I had been building for a year. Seven other bulls and cows made up the family. When the bull saw me he raised his trunk for a sniff. At the first whiff of my scent

(*Continued on page 153*)

"I Was Almost Cannibal Stew!"

(Continued from page 152)

his ears spread wide and his mighty feet shifted in irritation. He began that peculiar swaying motion which is indicative of an elephant's rising anger.

Twice the old bull snorted. No doubt these were orders for his fellows to stand by to charge, for, a few seconds later, he moved forward in a slow and stately stride. The stride became an even trot. Then, as a trained phalanx, the whole herd charged.

It was what I wanted, but I hadn't counted on the beasts flying off the handle so quickly. They must have been in a bad humor from the beginning. For their trumpetings now told me they were determined to make short work of the two-legged creatures who had interrupted their meal.

Osa cranked away for all she was worth. She saw the peril I was in. But we had long since schooled ourselves to get the film first and save our lives afterward.

I RAN at top speed. Sometimes we had been able to divert elephants by yelling and waving our arms. But this time I was too frightened to do more than stare at them. I tried to dodge. But the bull swerved almost as quickly as I. At a loud snort from him the other elephants spread out slightly, covering any further such maneuvers I might attempt. There wasn't a tree in sight for me to climb; not an inch of cover behind which I might hide.

Worst of all, when I had covered about half the distance back to Osa and the gun bearers another herd of about a dozen elephants suddenly appeared from my flank. They promptly joined the charge.

It was a desperate situation. Osa says she was scared stiff, but she kept turning the crank. She knew she was getting the greatest wild elephant picture ever taken.

By the time I reached the camera the elephants were only a few feet behind. I was too winded to shoot. Before I could have got my rifle in position the bull would have been upon me.

Osa, bless her heart, had not lost her nerve for a moment. And luckily her gun bearer had the pluck to stay at her elbow. Now, with a quick motion, she seized her high-powered piece from him and fired. Her target was physically as big as a barn. But she had to hit a spot the size of my hand, and hit it in the half-second during which it was moving at high speed across her line of vision.

ONCE more her cool, sharp eye saved my life. Her bullet found its mark in the elephant's absurdly small brain. Even then she did not drop him at once. His prodigious momentum carried him twenty feet onward. Fortunately he swerved slightly and fell just beyond the camera, dead as a doornail!

The rest of the herd, having lost their leader, at once hesitated. All of us yelled bloody murder. This and the bull's death were too much for the beasts. They hesitated, turned, and retreated pell-mell.

Yes, we have had plenty of close calls. We have had many other kinds of adventure—with wild buffalos, with treacherous hyenas and wild dogs, with deadly reptiles, and even with ostriches. I still bear the marks of an encounter with a leopard. Every day in the African wilds brings some new and unexpected situation to challenge skill and resourcefulness.

Perhaps when ordinary existence seems drab and monotonous, you envy us our exciting life. Yet, though there is a real tingle in adventure, and a thrill in accomplishing a hazardous task, I think our greatest feeling is one of satisfaction in being able to work on the hard frontiers of science and exploration.

The Real Fathers of Flight

(*Continued from page 53*)

taneous competition on both sides the Atlantic, Orville flying before the Kaiser and his hosts, Wilbur thrilling a few million of uncrowned New Yorkers. Cables tossed the front page tidings back and forth daily. Brother was eclipsing brother. Bets were placed on the record-smashing fraternal contest. It was thought to be an arranged affair, but in fact the happy rivalry was due to pure chance. It just happened that on the day Wilbur flew up the Hudson, Orville in Germany made a new passenger-carrying record of more than an hour and a half, with an altitude record of 1,600 feet.

The Crown Prince refused to be smiled off from his desire to take an air ride. He kept right after Orville, personally telephoning to him at his hotel. Orville interviewed the Empress and diplomatically asked whether it would be all right to give her eldest boy a ride. She said she did not mind. So the Crown Prince was gratified with a brief flight, and he recompensed the inventor with a diamond-studded stickpin.

KAISER WILHELM, as reward for a special flight in his presence at Potsdam, gave Orville an autographed photo of his imperially decorated self. Orville, with thanks, handed the picture to his sister.

"I see she has it already," laughed Wilhelm.

"Yes," replied Orville. "President Taft didn't even go through the formality of handing his picture to me. He handed it to her directly."

"That is where the American is more of a cavalier," observed the Kaiser.

Orville gave flying lessons to some Germans while Wilbur did the same to American Army officers at College Park, Maryland. When the brothers were reunited on this side in the late fall they organized a million-dollar company which had an ornate office in New York and a very different real office above the old bicycle shop at Dayton. Colleges began to grant degrees to the men who had never gone beyond high school. Honors were too numerous to keep track of.

With his brother and sister at a railroad station, Wilbur searched his pockets for tickets. A bit of red ribbon fell on the floor.

"Oh, yes, I forgot to tell you about that," said Wilbur, picking up the ribbon and handing it to Katharine.

It was the ribbon of the Legion of Honor which the brothers had received that afternoon at the hands of the French consul.

At eighty-two Father Wright had his first ride in his sons' vehicle. Orville held the craft down to a conservative altitude, whereupon his dauntless sire shouted:

"Higher!"

THE Wrights had exhibition flyers touring the country and one of them took Theodore Roosevelt up at St. Louis, while others participated in the first international aviation meet held in this country at Belmont Park, New York, October, 1910. The Wright machines won most of the prizes.

Wilbur went abroad the next year to testify in a suit against patent infringers. Orville went to Kitty Hawk to glide in a motorless plane in the fall of 1911. There he made a long-standing world's gliding record of almost ten minutes. It was marvelous—even though the record today is around fourteen hours.

The Wrights were planning a fine new home in the spring of 1912. Wilbur had written from abroad:

"All I want is a bathroom for myself."

He did not get it. He never saw the new mansion. On May 30, at the age of forty-five, his eyes that rivaled the eagle's closed forever in the simple cottage on Hawthorn Street where the brothers had first visioned and largely worked out one of mankind's greatest victories over Nature.

The doctors called it typhoid fever, but his friends believed that Wilbur was worn down to his grave by lawsuits. In his delirium he labored to tell the court all about the airplane, just how he and his brother created it, explaining a thousand intricate details. In a lucid period he said that when he recovered he wanted to spend the rest of his life helping other inventors.

The twenty-fifth anniversary of flight by the Wright brothers was celebrated last year in connection with the International Civil Aeronautics Conference at Washington. Delegates from many lands attended and paid homage to the unschooled geniuses of Dayton. Brazil declined to send a delegate on the ground that her favorite son, Santos-Dumont, was an air pioneer. It appears this is the last of the foreign claimants. It is our fault there have been any. Once the roll of pseudo-fathers of aviation was quite lengthy.

There were triple ceremonies last December at Dayton, Washington, and Kitty Hawk. At the function in the national capital President Coolidge made an address lauding the Wrights with a meed of careful credit to their predecessors. Congress voted the Distinguished Flying Cross to the inventor and to his departed brother.

DURING the ceremonies here, Frenchmen across the sea gathered to lay a wreath upon the monument to Wilbur Wright at Le Mans, where he gave the old world its first view of the new world's discovery. In England on the eve of December 17—a date most historic—a banquet table was set for one hundred persons in the Science museum, London, beneath the widespread uplifted wings of the machine in which man conquered the air at Kitty Hawk. Prominent persons spoke, the Wrights were toasted, a cable from Orville was read.

If Orville Wright felt that suitable amends had been made here for the doubts that had been cast on the brothers' priority as conquerors of the air, he did not signify it by recalling the virgin aircraft from its exile in London. He spoke no word at any of the triple ceremonies which he attended.

A frail age-weary figure, none of his kin beside him, Orville stood in a peopled solitude by a monument newly erected by the citizens of Kitty Hawk to mark the spot where two nimble young men had begun to assemble their first glider a generation before. Some of the folks standing near by had a ghostly familiarity.

Why, of course, Postmaster Tate! Boarded at his house; Wilbur used his wife's sewing machine and his little girls had sateen dresses out of the glider wings! Glad to see you, Postmaster. But who are these three men? By jiminy, they're the brawny sun-tanned life guards of the Government station who helped to launch the power machine on that bleak winter day in 1903. Daniels, Dough, and Etheridge. Boys, you look fine. That was a great day, wasn't it? Let's see, a couple of chaps are missing. Brinkley, a lumber buyer. And where's Johnny Moore? He was only sixteen years old and I guess that roaring engine scared him just a mite. . . .

Secretary of War Davis spoke and there were addresses by Senator Bingham and Congressman Lindsay Warren.

Orville Wright did not seem to hear or heed the words of eulogy. His eyes roamed over the desert of sand with its curved wind-made hills ideal for gliding—wonderful sport! How about the wind today?—across the waters of Albemarle Sound and toward the surging Atlantic ocean where the eagles used to steal the prey of fish hawks, watched by two young men who planned to steal from the eagles their dominion of the sky—and did so!

THE END

How to Start Your House Right

(Continued from page 73)

amply strong. Another material that has great strength and stiffness with even less weight is hollow tile, made of hard burned clay.

Walls made of stone or brick have their own natural finish. To get color they can be painted or whitewashed, but usually they are left as they are. There is great variety in the color of stone, of course, while brick is made in so wide a range of color and texture that any desire can be satisfied. Speaking generally, there are two classes of brick—unglazed common brick and hard-surfaced or glazed face brick, both being in wide use. As face brick is more expensive, it is used only for surfacing and for special effects.

The natural finishes of concrete and of the ordinary form of hollow tile, on the other hand, have no special attraction, although for designs that are rugged and sturdy the rough surface of poured concrete may add to the effect, and for others the unfinished concrete block or hollow tile may be appropriate. As a general rule, however, they are veneered with some attractive surface finish.

ONE of these finishes is stucco, which is usually applied in three coats, with the outer coat waterproofed. Stucco will penetrate the surface of concrete and become a permanent part of it. Hollow tile, being burned, is not sufficiently porous for this, but gives an excellent bond if roughened and scored with dovetail grooves that give a firm anchorage. Concrete is veneered with brick by laying the brick against it with mortar joints, while hollow tile is so made that at intervals the bricks project into it. Tile and brick are thus bound so firmly together that they form one wall rather than a wall with a veneer.

Unless air spaces are built into a wall the rooms will be cold and clammy, for the difference in temperature indoors and out will condense moisture on the inside walls. In solid masonry walls air spaces are obtained by setting the inside finish an inch or two away from the inner surface. For safety this is usually done with hollow walls as well.

Such walls, which bear the weight and also keep out the weather, will last indefinitely without expense for care and repair, and as they are also fireproof, there is nothing about them to cause the owner worry.

A FRAME wall begins with a stout timber laid on the foundation to serve as the base for the uprights that are the skeleton of the wall, the heavy posts at the corners, and the lighter studs that are spaced between them. In small houses the studs reach to the roof; more often they go only to the next floor, where they are connected by horizontal timbers that support the floor beams and the next tier of uprights. This frame is strong enough to carry the weight, but has so little stiffness sideways that it must be braced; otherwise the house will be as shaky as a loosened packing case.

The usual method of bracing the frame is to cover it with planks, preferably nailed on diagonally; but lately use is being made of long and wide sheets of artificial lumber made of wood, cane, or some similar fiber. These sheets are put on vertically, and being wide enough to stretch over four studs, are said to brace a frame as effectively as the older method and at less cost. Another substitute for planks is gypsum plaster in thick sheets inclosed in tough paper.

To keep out moisture, a plank sheathing is covered with building paper, which is impregnated with tar or asphalt to make it waterproof; this is also necessary with artificial lumber that is not waterproofed during manufacture.

Up to this point there is little or no difference in construction for (Continued on page 156)

How to Start Your House Right

(*Continued from page 155*)

a finish of wood or of masonry, except that as wood finish is not expected to act as a stiffener, special care must be given to the bracing of a clapboard or a shingle wall. Brick and stucco, on the other hand, being stiff in themselves, add greatly to the rigidity of a house. Clapboards and shingles are applied to the sheathing over the building paper. Brick and stucco are set an inch or so away from it to provide an air space.

A brick veneer rests on the foundation wall, which is made wide enough to receive it. To tie the bricks to the inner wall, stout nails or heavy wire loops are driven into the sheathing at frequent intervals, the outer ends being embedded in the mortar joints between the bricks. For stucco, metal lath is nailed to the sheathing, leaving a small space between. Thus, while the weight of a brick veneer rests on the foundation, stucco veneer is supported by the frame, which must be strong enough to carry its additional weight.

ANOTHER form of stucco veneer is so stiff that there is no need to use sheathing. For this, metal lath is nailed directly to the studs and given the first coat of stucco; when this has hardened another coat of stucco is applied from the inside to the back of the first coat, so that the lath becomes the center of a thick slab. This is called back-plastering, and with building paper laid between the studs has been found very satisfactory. Some forms of metal lath give much the same effect without actual back-plastering. Such lath, of wide mesh, is backed by building paper as it is nailed to the studs. Thus the stucco, when applied, is supported by the paper, which acts as a mold in forming it into a slab reinforced by the lath.

For good results, a stucco wall must be built carefully, otherwise it will crack and even go to pieces. Since it is attached to the wood frame, the two must move together. An unequal settlement will put the stucco under a strain that it may not be able to stand. Stucco is often blamed for a failure that is really due to poor framing or weak foundations. Another cause of cracking is the use of wood lath in place of metal.

With all of these materials and methods to choose from, the Kerseys might have had trouble in making their selection had not the question been more or less settled by the house design that they wanted. The sketch showed masonry walls for the first story, and as native stone was scarce they decided to build them of brick. There could be no doubt as to the material for the second story, for only clapboards would carry out the architect's conceptions. And so, with these points settled, they returned to their friend the architect to be started on another line of inquiry.

THE construction of a home is one of the most important investments of a lifetime. And it should be considered as any other investment, thought being given to the costs of maintenance and repairs as well as to initial costs. Frequently, a low first cost means shoddy materials and excessively high costs later on.

Popular Science Institute believes that structural materials selected on a basis of quality rather than price will pay dividends. Adequate insulation, modern heating equipment, and the installation of time and labor saving electrical devices will make a home more livable and less expensive.

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A New Ice Age May Bury Us

(Continued from page 22)

the whole United States—those who have refused to desert their homes. With furs and sleds, they prepare to live the life of Eskimos.

That is the startling picture suggested by the eminent Danish geologist, Dr. V. Nordmann, who says, "there is absolutely no reason why we should not have another glacial era." But certainly it will not happen for at least 20,000 years.

Repeatedly glaciers have visited the earth before. Three times, perhaps four, huge glaciers have swept down from the poles and smothered what are now temperate regions in ice blankets a mile deep. Traces of their visits are visible today in rock scratches and heaps of alien boulders piled up in Kansas, Illinois, Wisconsin, Iowa, and elsewhere—marking the southern boundary of the sheets that in the east encroached as far as New York City. Alaska's glaciers today, and Switzerland's too, are remnants of this ice sheet, while at the North and South Poles remain huge ice caps so wide and thick that their melting would raise the ocean level by fifty feet—completely submerging San Francisco, Los Angeles, New Orleans, New York, and Washington.

NIAGARA FALLS, also, is believed to be a reminder left us by the last glacier, which blockaded an ancient river stream and diverted the outlet of Lake Erie to its present course. Since the Falls have receded at a fairly fixed rate of some three feet a year since that time, and today have eaten away a ravine seven miles long, we have a fairly accurate "chronometer" that dates the last glacial epoch at about 12,000 years ago.

Is another due? Some authorities have seen in Europe's intensely cold winter, just past, indications that we may be approaching another Ice Age. Dr. Nordmann, the Danish expert, thinks it likely, but makes it plain that we are in no immediate danger.

"I believe," he says, "that the earth still has to pass through one or more glacial periods. I think it likely that in another 20,000 or 25,000 years we shall taste the experience of another icebound age."

Additional evidence to support his belief is seen by Prof. Walther Gothan, of the Prussian Geological Survey, in the shrinking of European forests of beech trees, which according to fossil evidence appear to be warm-weather trees characteristic of a period between glacial invasions.

JUST what causes the glacial invasions is a mystery. Perhaps, as has been suggested, our sun is a "variable star" and waxes and wanes over periods of thousands of years—the waning periods inducing a frigid climate on earth. Another explanation is that a slight change in the earth's atmosphere, such as a variation of the amount of carbon dioxide, might be responsible.

Geologists agree that some 1,000,000 years ago the first Ice Age wrapped the earth in its chilly embrace—and that at irregular intervals of perhaps 400,000 years other Ice Ages have appeared, alternating with periods of mild weather.

Man owes his civilization largely to one of these, experts declare. When the last Ice Age struck the earth, and our savage, prehistoric ancestors fled into caves for protection, the first step in civilization began.

"This very revolutionary period," says Prof. Henry Fairfield Osborn, of the American Museum of Natural History, "was essential to human development because it forced man's inventiveness. He created fire, devised tools, developed an artistic sense and, having ceased to wander so much, sat about the fire in his cave and began the formation of his intellectual powers." From that dim beginning, long though the gap is, dates the modern home!

Longest Airway Links Americas

(Continued from page 51)

airways system. On one of its lines, already mentioned, seaplanes daily follow the snaky Magdalena River over a tangle of tropical undergrowth from Barranquilla, on the Caribbean coast, to Neiva, far in the interior. Another line runs to Buenaventura, and thence has recently been extended to Guayaquil, in Ecuador. Every city of importance in Colombia is within easy access to an air line. Imagine what that means in a country where it has been unusual to send a wire and get a response the same day; where there is not even a telegraph line through the mountains between many points. Under such circumstances, no one minds the cost of air travel—not even a portly gentleman who pays extra fare if his weight exceeds a hundred and sixty-three pounds, the limit.

OTHER countries in South America have developed impressive air services. The extensive system of the Lloyd Aero Boliviano offers access to hitherto almost inaccessible sections of Bolivia, "at the top of the world." Chile's air line between the inland city of Santiago and Valparaiso, on the Pacific coast, recently has been extended all the way to Arica on the northern border. In addition to the San Ramon-Iquitos service in Peru, an American-owned line operates planes along the Pacific coast from Mollendo north to Talara, also in Peru.

These lines are the skeleton of a gigantic aerial hook-up that now seems destined to cover South America, under the spur of Uncle Sam's new airways reaching down to meet them.

For some time an American concern, Pan-American Airways, has held the mail contract for an extension of its routes from Miami, Fla., along the Atlantic Coast of South America as far as Paramaribo, in Dutch Guiana. One route is in operation as far as Santo Domingo, in the West Indies, whence it will eventually complete its course to South America via the Leeward Islands. The other, through Central America, was recently opened as far as Panama by Colonel Lindbergh. At Cristobal, in Panama, the proposed mail route wings east to join the other.

To the Pan-American-Grace Airways, Uncle Sam has entrusted the gigantic project mentioned at the outset of this article—the 4,300-mile air mail link from Florida to Santiago, Chile. This, it is expected, will make it possible to whisk a letter in one week's time from New York to Chile—as against the twenty-one days now required by steamer.

ALREADY a link across the continent—over the snow-capped Andes and past crystal lakes in the towering mountains, from Valparaiso to Buenos Aires—has been surveyed both by American and French concerns. An east coast route to join French and German air lines with the new American route to Guiana also has been surveyed. In Brazil, further extensions are planned. This great country, bisected across its entire width by the strange meanderings of the Amazon River, offers ideal routes for seaplane lines through boundless forests of exotic woods. Six lines penetrating the remote interior regions are contemplated, of which one will run nearly to the Peruvian border.

For the first time, when these lines are completed, hitherto inaccessible provinces will share with those more favored, a commerce that should rival that of any empire in the world. Such strange products as annatto seed, copaiba gum, tungsten, alpaca wool, balata, tonka beans, molybdenum, ox gall and kapok, to mention a few of South America's important products, will step into prominence in American markets.

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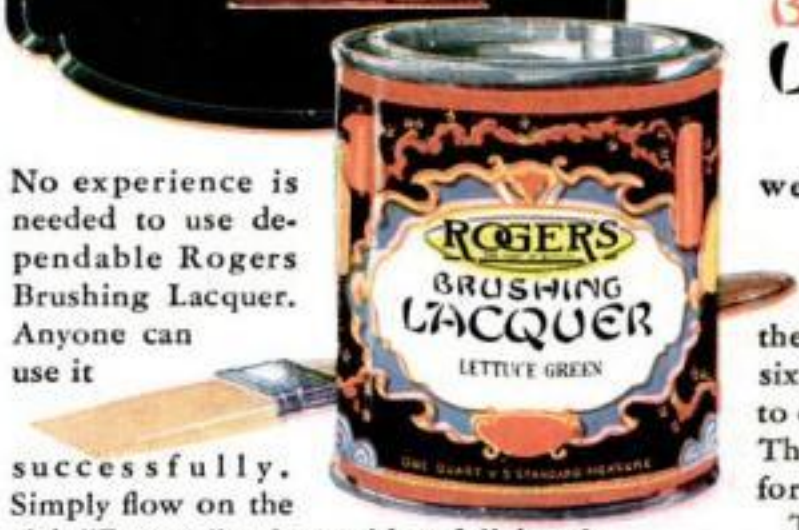

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